The Chemical Age

VOL LXIV 9 JUNE 1951 No 1665

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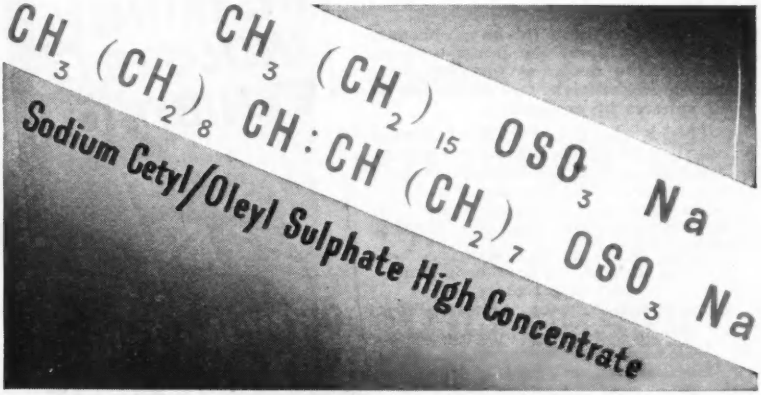
Marchon



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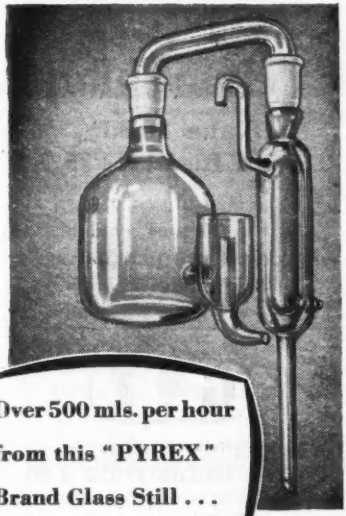

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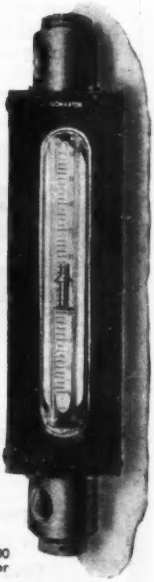

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The
Chemical Age

Established 1919

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Prospecting Prospects

IN many quarters the view has been held that the most powerful cause of the world's present raw material difficulties is that progress in making finished goods or in building up refined products has been much greater and far speedier than progress in developing the output of raw or basic substances. It has needed no more than the current clashing of demands—for peace, for rearmament, and for improving the conditions of the poorer countries—to show that too much secondary production is trying to establish itself upon too small a foundation of primary production. Yet, so far as mineral deposits are concerned, the skin-deep surface of the earth must be regarded as still only slightly explored and exploited. The fairly recent discovery of huge potash salt deposits in Britain is a notable example—and its origin was accident rather than design, for the potash was first found in prospecting for oil. If discoveries such as this can occur in a congested and long-industrialised island, how much more raw material wealth remains to be found in the far larger land masses of the West and East?

In this connection new and practical plans to encourage prospecting in the United States are exceedingly interesting. Funds will be made available to genuine prospecting efforts and the proportion of total costs met by these funds varies according to the scarcity position of the minerals concerned. Thus, government aid up to 90 per cent of total cost can be granted for approval projects in search of uranium, spinning-grade asbestos, beryl, cobalt, columbium-tantalum, corundum, cryolite, industrial diamonds, kyanite, mica, nickel, platinum-group metals, piezo-electric quartz crystals, steatite, and tin. A 75 per cent contribution is possible for antimony, manganese, mercury, and tungsten. Chromium, copper, fluorspar, graphite, iron, lead, molybdenum, sulphur, zinc, and cadmium projects are rated at 50 per cent for maximum contributions. The share of costs to be met by the prospecting organisation or individual need not necessarily take the form of money, it can be assessed in terms of the supply of labour at a fair cost, the rental of plant owned by the applicants, or similar contributions in kind. The most definite regulation is that the applicant must either own the land on which prospecting is to take place or must have the land available on a long lease. This bold scheme will be administered by the U.S. Department of the Interior but the

investigation of applications will be in the hands of the Bureau of Mines and Geological Survey.

By contrast, Britain, with a considerably planned economy in which the principles of state aid and state control are accepted far more extensively than in America, has so far shown much less imagination. The recommendations of the Mineral Development Committee (1949) are milk-and-watery indeed compared with the new U.S. scheme. Admittedly the committee was considering mineral development at a time when world supplies seemed less strained, but Britain's necessity to import many vital minerals and her capacity to pay for them created a problem that was no less urgent or serious *then* than the problem facing the United States *now*. Britain's plans to encourage the search for new mineral deposits tied financial assistance to the management of property rights in minerals 'on behalf of the nation'. Assistance less tied to the chariot of state ownership or management took the form of a recommendation that income tax demands should be eased in their method of presentation, for example, that losses in early years could be carried forward over longer periods and not set off against the first profits available. In case, however, these proposals seemed too encouraging, the committee made it clear that any large and important deposits should be *ipso facto* cases for 'the nationalisation of mineral rights'. With reservations by only one member, the committee urged that the new Yorkshire potash deposits should be separately nationalised unless their general recommendation for nationalising mineral rights was implemented 'in a very short time'. Nor could the development of mineral resources be liberated from bondage to the post-war Town and Country Planning Act—all that was recommended was that development charges should be levied as annual payments rather than as capital sums!

Could there be sharper contrast between two national policies? In the United States, a clear-cut scheme for giving 50 per cent to 90 per cent financial assistance in mineral prospecting and development has been quickly put into action. Here far less encouraging proposals—forbiddingly framed with intentions to nationalise any important or successful discovery—are in storage (perhaps fortunately) as a two-year-old committee report.

On Other Pages

The annual subscription to THE CHEMICAL AGE is 35s. Single copies, 9d.; post paid, 1s.; SCOTTISH OFFICE: 116 Hope Street, Glasgow (Central 3970). MIDLANDS OFFICE: Daimler House, Paradise Street, Birmingham Midland 0784-5). THE CHEMICAL AGE offices are closed on Saturdays in accordance with the adoption of the five-day week by Benn Brothers, Limited.

Notes & Comments

Russian Dependence

AN interesting sidelight on the extent to which Russian organic chemists have used and are using the chemical literature of the Western world, and how much they are using their own, was given by a group of scientists writing in the U.S. *Journal of Chemical Education* last month. Research showed that the Russian chemist relies on the chemical literature of other countries to a greater extent than the American chemist. The German chemical literature was until recently the principal source of his information, as far as organic chemistry was concerned, comprising as much as 50 per cent of his references in 1913, but coming down to 36 per cent in 1948—much the same proportion as the number of references to Russian literature. Reference to this has naturally risen, from 30 per cent in 1913 to 38 per cent in 1948. German references rose as high as 60 per cent in 1929 when Russian research was being rapidly expanded, but the decline of German influence followed, not only in Russia but in the U.S.A. as well, as a direct result of the rise of American chemical research, whose references trebled in Russia from 4½ per cent to 13 in the next ten years, and are now even higher. The increase in Russian references to American literature has not been reciprocated by American references to Russian literature, which have ranged from 0.7 to 2 per cent only, but comparatively few American chemists are engaged on studying Russian literature at present, in spite of the fact that the availability of the Russian periodical references usually exceeds 80 per cent. The chemical literature of England, France, and other contributors has not undergone any significant change over the period remaining at a steady 6-8 per cent.

Research Progress

IN the United States research has increased several times since the end of the war, says Dr. Clyde Williams, director of the Batelle Institute, a private research organisation. Speaking before a meeting of the American Institute of Chemists at Cleveland, Ohio, he declared: 'In 1940, industry and the Government spent about $345,000,000 on science and research, but this year we are spending at the rate of $2,000,000,000 a year. Thus we are now spending more than five times as much on technology as we did ten years ago. More important, our laboratories are handling this load without undue strain. Because of this growth the nation is in an excellent position to solve any technological problems that might arise in a national crisis'. With present facilities and the manpower available the United States could increase its research activities even further, he said. The war changed to a large degree America's former dependence on scientific principles developed in other countries so that now her scientists are paying more attention to fundamental research, and Dr. Williams predicts that Americans can confidently assume that progress will continue at an accelerated rate.

Our Greatest Resource

THIS tremendous expansion in research and technology in the United States is a heartening foundation to the well-being and defence needs of the Western World. In Great Britain the emphasis, until recently, perhaps, has always been on fundamental research rather than on its application. Now more and more industrial work is being done. Research and technology is the Free World's greatest resource and there need be no limits to its industrial progress. As Dr. Williams pointed out at Cleveland, 'this great resource, unlike natural resources, is not necessarily subject to depletion. In our system of free economy it can only grow and become more productive.' Welcoming this growth in America, we in Britain will endeavour to make certain that this country will do its fair share for the benefit of all those whose ideals and aims are the same as our own.

U.S. Plastics Research

Important Advances in Mechanical Properties

PROMISE of a new fast method for control of cure of plastics in commercial moulding operations, and the discovery that molecular re-orientation will increase the tensile strength of polystyrene three-fold are among the year's results reported this week to sponsors of a fundamental research programme on plastics being carried out at Massachusetts Institute of Technology, U.S.A.

The sponsors, all members of the Manufacturing Chemists' Association, have been co-operating with M.I.T. through an M.C.A. Plastics Technical Sub-committee to give advice and steer the project during its six years of operation. At M.I.T., the work is under the direction of Professor A. G. H. Dietz.

Significant Results

Earlier significant results from the research have included the development of new machines and techniques for testing plastics, methods of casting thin films for the determination of mechanical properties, and demonstration of the utility of the turbidimeter for measuring molecular weight distribution of thermoplastic polymers. Principal objective of the programme is to fill gaps in existing data and provide the material necessary for development of theories on the fundamental behaviour of plastics under mechanical stress.

In work currently in progress, using ultrasonics, it has been shown that transmission and absorption of sound waves through thermosetting resins varies with their degree of cure. The rate and extent of cure can be followed by measuring the changes in velocity and intensity of sound waves passing through the plastics while it is in process of curing. These changes may be plotted graphically and correlated with other physical properties such as hardness, flexural strength, etc.

For the first time, it now seems possible as a result of this work to study in detail the changes taking place on curing of thermosetting resins as a function of temperature, type of catalyst, catalyst concentration and type of resin. Of equal importance, the investigations indicate a good possibility of developing a reliable, accurate and fast test method for commercial use in control of the degree of cure of thermosetting resins in the moulding shops, according to Professor Dietz.

Like other thermoplastics, polystyrene is composed of long chain-like molecules tangled together like bagged wool fleece. This results in a material that is relatively brittle. When strained too far, as by bending or pulling, it cracks and finally breaks with a fracture which resembles that of glass. Such a fracture is called conchoidal, or shell-like, and indicates but little stretching before rupture.

By 'combing' the polystyrene, however, so that the molecules lay more parallel, the M.I.T. researchers found that they were able to alter the characteristics of the material considerably. The combing, or orienting, was accomplished by stretching the polystyrene while it was hot enough to be plastic. After cooling, the stretched pieces showed ultimate strengths in the direction of stretch orientation approximately threefold those of the unstretched pieces.

In highly stretched samples, the tendency to develop little cracks before rupture, known as crazing, disappeared. Under load sufficient to produce ultimate fracture, the oriented polystyrene exhibited much increased stretch (ductility) and behaved like steel or copper. Before rupture, the specimen 'necked down' at the place where fracture finally occurred, and the fracture was no longer shell-like but fibrous, like the ends of a thread which have been pulled apart.

Various Ideas Tried

Various ideas were tried for the measurement of the degree of orientation. Low angle X-ray diffraction pattern and bi-refringence of visible light showed that only a low order of orientation results from the stretching. No development of crystalline areas, as in metals, was found in polystyrene so prepared.

This new knowledge concerning the behaviour of polystyrene is already being applied in the production of sheets of flexible polystyrene. It also clearly indicates the possibility of a polystyrene fibre for certain fabrics used for special purposes.

NPL Celebrates Fifty-First Anniversary

Results of Recent Work on Show at 'Open Day'

WORK of the National Physical Laboratory was described by its director, Dr. E. C. Bullard at its annual Open Day held on Wednesday, 23 May.

Opening of the central building at Bushey House, 51 years ago, was recalled by the doctor, who said that the celebration of the laboratory's half century had been postponed until this year to coincide with the Festival of Britain.

Importance of a programme of research for the production of pure iron was stressed by Dr. Bullard, who quoted a figure of 99.997 per cent as the percentage of the highest quality iron produced. The figure for iron produced on a larger scale was rather less.

Properties of iron depended to a large extent upon the presence of small amounts of contaminants, even the oxygen of the air playing some part in this modification. Until the very purest iron was available it was difficult to study the effects of these contaminants. A systematic inquiry was being undertaken to study the controlled contamination of pure iron.

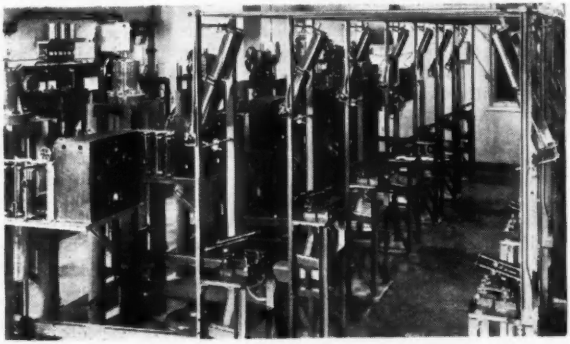
Visitors were allowed to walk freely about the laboratories, to inspect the many exhibits, and discuss them with the staff. During the day talks were given upon the production of diffraction gratings and economy in structural design. In addition many of the separate laboratories gave demonstrations, the high voltage laboratory in particular showing an 800,000 volt A.C. discharge between two parallel conductors.

Examination and determination of the strength of materials has been carried out for a considerable time by the Engineering Division. In particular, considerable attention has been paid to the behaviour of various steels and light alloys under rapidly repeated or fluctuating fatigue stresses, since the majority of failures of high speed engines and machines in service are due to stresses of this nature.

Research has improved design by indicating which structures are dangerous stress raisers and it has been found that the effects of these irregularities such as screw threads, oil holes, rough surfaces, and so on, increases with the size of the part. Much work has been done on the fatigue strength of screw threads particularly in connection with the development of the Unified thread form now adopted by this country, the U.S.A. and Canada.

This work has led to the development of new fatigue testing machines such as the Multiple Unit Direct Stress Fatigue Testing Machine which was on show. This machine tests 24 specimens at the same time. The model shown was made for tests upon small screws, and provides load ranges up to 50 lb. Examples of failure of machine parts in service were on show and also apparatus for the measurement of elastic constants using small specimens by the ultrasonic pulse technique.

Many of our modern power units such



General view of creep laboratory, Engineering Division, NPL showing 5-ton creep machines

as high pressure steam plants and gas turbines require the materials of their construction to be submitted to high stresses at elevated temperatures. To investigate the suitability of materials for these purposes a systematic study of their deformation when subjected to varying stresses and temperature must be made. Work in this field started at the National Physical Laboratory as early as the 1930s.

Scope Widened

Scope of investigation has widened so much that there are now in existence two large laboratories which are air and temperature controlled, and which house more than 90 test machines. Much of the information about high temperature materials which were required for the development of the gas turbine was made available by these laboratories. They were the first to make a comprehensive study of the problems associated with creep and many other similar organisations have been set up modelled upon them.

Set up in 1940, the present laboratories house some 79 sensitive creep testing machines of NPL design which have been reproduced widely in this country and abroad. In these machines the specimen is in the form of a hollow cylinder or tube with flanged ends. One end is secured in a fixed head and the load is applied to the other end by a lever mechanism, the specimen hanging vertically downwards.

Deformation of the sample is measured by means of an extensometer which uses the optical lever principle to magnify the very small movements of the free end of the sample. In order to measure the effects of elevated temperatures the specimens may be heated by means of an electric furnace around the sample. These cylindrical furnaces are fitted with temperature controlling devices which keep the temperature steady to one-half of a degree. Some very long term experiments were being undertaken, one specimen having been under test for eight years.

Among the machines on show were some designed to study problems associated with addition of torsion stresses to the normal tensile stresses. This is important because in practice most machine components are subjected to complex stresses, and it is very seldom that a simple tensile stress is encountered.

One combined tension-torsion machine was built to study the short-time plastic behaviour of metals. Some machines were being used to study the bending and torsion of specimens. The simple torsion machine is extremely sensitive and can measure creep strain rates down to the very low value of 10^{-9} per hour. Tensile and creep equipment has been developed for tests on metals and ceramic-metal aggregates at temperatures up to 1200° C.

Another machine has been used to study the bending of light alloy struts due to creep at room temperature when the struts are loaded concentrically.

High temperature plants are subjected to variations in temperature and often to variations in stress which are due to changes in load output requirements. The effect of these changes upon the materials of their construction are obviously of great importance, and the constructional engineer must be able to predict them and design in such a fashion that deleterious effects are avoided. Apparatus has therefore been devised to study creep when both the stress and temperature of specimens are varied automatically in pre-arranged cyclic periods.

Creep of metals when subjected to compression is also being studied, but this is a more difficult problem than that of tensile creep, because of 'end effects.' The sample is compressed between two flat steel plates, one fixed and the other free to move, and applying the compression. Only a small sample can be used to avoid the effects due to bending.

Sensitive Creep Tests

More fundamental are the experiments in which metal specimens are studied in a creep machine of very high sensitivity. The creep is measured in the region below that at which plastic flow takes place, that is below the elastic limit. Results indicate that even within this range there is a steady and observable creep, the rate rising with temperature. Knowledge of this type is gradually modifying our classical ideas upon the elasticity of metals.

In the Metrology Division an investigation into the stability of analytical weights, particularly those used in chemical laboratories, has been carried out. It is important that analytical weights used regularly in a chemical laboratory should remain unchanged in mass over long periods and

should be unaffected by the atmosphere in which they are kept.

Plain polished, lacquered, or thinly plated brass weights frequently used are often unstable even under the best working conditions. A range of superior weights is now available, and the assessment of their relative merits under working conditions has been attempted.

The mass of a weight may change due to four main causes. These are corrosion, adsorbed films and film deposits, wear, and release of occluded gas. The first two result in an increase of the mass, and the second two in a loss of mass. This neglects the effect of accumulated dust, but it is presumed that the weights are dusted lightly before use.

Wear is the most constant and obvious cause of loss of weight, but it can also be produced by the release of occluded gas. Experience with standard weights has shown that platinum or the harder alloy platinum-iridium are most suitable materials for producing weights which are stable. The five NPL working standard 100g. weights which are made of this material have not changed by more than 0.16 mg., but they have been used under good working conditions.

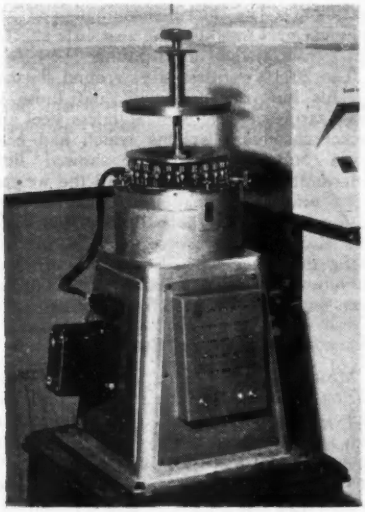
The three oldest which have been in use daily for more than 28 years have not, however, changed in mass by more than 0.04 mg. All the three weights have lost mass, and this must be attributed to wear, although some additive effects may have been masked. The greater loss in weight of the two more recent standards which have been very little used must be attributed to loss of occluded gas.

Weights of non-magnetic nickel chromium alloy have been available in this country since 1939 and recently austenitic stainless steel containing 25 per cent chromium and 20 per cent nickel has been used in the manufacture of weights in this country because of its high resistance to corrosion. Three highly polished 100 g. weights made from this material have been stored under good conditions at the NPL for six years and have remained stable to within the limits of test, that is, to within 0.01 mg.

Nickel chromium and stainless steel weights are largely replacing those made from polished or protected brass for all but the most approximate weighings. Brass would not be expected to stand up to corrosive atmospheric conditions, but investigation has shown that even under good conditions brass weights form an even tarnished film and frequently corrode to the extent of local pitting. This effect is observed in weights which have been exposed to severe laboratory conditions in an extreme form which gives the weight a speckled appearance and a noticeable increase in mass.

Protection of brass weights by a thin coating of an inert material reduces these effects, but may have introduced new sources of error. Thus the lacquers which have been used for this purpose are frequently hygroscopic, while the gold plating, which has been used for a very long time as a protective layer, may contain pin holes and, in addition, being soft is particularly subject to wear with the resulting loss of mass more appreciable because of the denser character of gold.

Gold plated weights have been largely replaced by weights plated with chromium, rhodium, platinum and nickel. Nickel



Multiple Unit Direct Stress Fatigue Testing Machine for miniature test pieces. This machine is designed to subject 24 test pieces simultaneously to tensile loading at 3,000 cycles per minute

plating has a tendency to fog and, in addition, nickel is slightly magnetic, but this type of weight is still used in some foreign countries. Platinum plated weights kept at the NPL since 1922 have proved extraordinarily stable, but these have been the exception rather than the rule.

In order to obtain information on the resistance of various types of weights to the corrosive atmospheres frequently found in laboratories, a representative group of 100 *g.* weights was exposed for two periods of three months over the working bench in five different chemical laboratories in the London area.

Method of Exposure

During exposure the weights were housed in a two-tier container, which was designed to permit the free ventilation of the specimens, while restricting the entry of gross dust. Each weight rested upon acid-free tissue paper and the container was constructed of anodised aluminium.

After the test it was found that most of the weights had suffered a marked change in appearance, the least affected in this respect being the chromium-plated specimens. This may have been due to the fact that the underlying deposit, nickel, changes much less in appearance than silver or brass upon atmospheric corrosion, the latter metals being immediately below the rhodium and platinum. The nickel-chromium and the stainless steel weights were also little affected apart from a slight local pitting.

The 20/10 stainless steel ground finished weights had rusted heavily and those of brass tarnished severely. Stainless steel and nickel chromium weights which had been given only one exposure showed little deterioration. The bases of all the weights were practically unaffected and the corrosion was less at the bottom of the sides, but elsewhere the corrosion was greatest along the edges where, owing to the high curvature, excessive amounts of metal had been removed during buffing after polishing.

No Unusual Conditions

Most of the weights gained in mass during exposure, but the stainless steel and nickel-chromium weights lost between the two exposures probably owing to the detachment of corrosion products. A continuous record of the humidity in each laboratory showed no unusual conditions, and the humidity was usually well below the 70 per cent level. Above this level it has been observed that the tendency to corrode markedly increases.

More heavily-plated weights experienced the smallest change in mass and there was little to choose between them. Among the highly polished weights the 25/20 stainless steel was the least affected, and although exposed to the severest laboratory conditions, the change in weight was less than 0.1 mg. The 20/10 stainless steel deteriorated very badly during the first exposure to laboratory conditions, and it was not thought worth while to prepare highly polished specimens although they would probably have been better than the ground polished specimens.

General conclusion arrived at was that the most stable weights under all conditions were those made from austenitic stainless steel (25 per cent Cr 20 per cent Ni) and non-magnetic nickel chromium alloy (80 per cent Ni 20 per cent Cr). Coated brass weights should have a substantial thickness of plating and flash coatings were little better than the plain polished brass itself.

In the Electricity division there was a demonstration of the measurement of the refractive index of air. As most modern precision measurements of length are made in terms of the wavelength of light, it is of interest to know the ratio of the speed of light in air and *in vacua*. This will, of course, depend upon atmospheric conditions and standard conditions must be specified.

This ratio, which is the refractive index of air, is also of interest in radar and has therefore been measured with 1.25 cm. radio waves. The method used involves measuring the change in frequency when a cavity resonator is filled with air and then evacuated.

Dielectric properties of solids and liquids were being investigated at frequencies up to 500 Mc/s. The liquids were contained in a polythene cup and due allowance made for the contribution of the container.

Measurement of Colours

Measurement of colours phototelectrically was demonstrated in the laboratory of the Light Division (Optics). In the instrument used the colour is spread into a spectrum by means of a spectroscope and a template is placed in the plane of the spectrum and

adjusted so as to make the combined response of the spectroscope and photocell equal to that of the average human eye.

If a single spectroscope is used the stray light can be troublesome with saturated colours such as reds and blues or with fluorescent lamps. This is eliminated by the use of a second spectroscope, but only a single prism is necessary as the light is reversed through the same prism to purify it. The extra image so produced allows the use of an exploring slit.

A collection of apparatus for making iron of high purity in considerable quantity was displayed in the Metallurgy Laboratory. In this process iron of the highest quality commercially available is melted in an oxidising atmosphere to reduce the concentration of some of the impurities. It is then transferred to a vacuum furnace and any residual oxygen is removed from the iron by maintaining a slight pressure of hydrogen within the furnace.

Samples Being Studied

Samples of iron produced in this way are being studied for their mechanical properties, very little information being available upon this subject. The iron which has been produced is very brittle at low temperatures. the change from ductile to brittle fracture taking place over a very small range of temperature. There was on show a demonstration of the effect of small quantities of alloying constituents upon the onset of brittle fracture.

Metals are also examined by the techniques of X-ray diffraction and electron microscopy in addition to examination under the microscope using phase contrast, interference or polarised light.

There was an interesting display of equilibrium diagrams which have been worked out in the laboratory. These illustrate the effects upon an alloy when the temperature is raised and the composition changed. In order to obtain accurate results only metals of the highest purity can be used. It was frequently found necessary to prepare these in the laboratory as sufficiently pure specimens could not be obtained commercially.

In the high voltage laboratory a great deal of specialised test work is carried out for industry. This includes breakdown tests upon insulators both with impulse and power frequency voltages, breakdown tests upon high voltage cables and impulse tests upon transformers. An exhibit showed the cathode ray oscillograph display of the wave shapes of the applied voltage and of the current at the end of the earthed winding under test, and the effect of a breakdown across a portion of the winding. Another piece of high voltage equipment on show was a two million volt Van de Graaf X-ray generator housed in the laboratory of the Physical Division.

Kent Receiver Recorder

GEORGE Kent, Ltd., announce a new multipoint air-operated receiver recorder for use in industries where automatic process control has been adopted. This instrument is a pneumatic version of the usual electric telemeter or telerecorder, which records several measured variables at a point remote from the actual place of measurement. It has been produced for use in those industries where electrical systems are dangerous because of fire risk, as in the petroleum and chemical industries. It also has obvious advantages where air-operated control schemes are already in use. The recorder provides a synchronised side-by-side record of the principal measured or controlled variables in a system, and can be used in conjunction with any transmitter provided it emits the required pressure ranges. It records on a chart divided into three zones and can operate on 3, 4, 5 or 6 points, if necessary with different coloured inks. The synchronous A.C. motor driving the chart lasts for two months at standard speed, and the instrument weighs 70 lb. Maximum working distance from the transmitter is 1,000 ft.

International Nickel

The report of The International Nickel Company of Canada, Ltd., and subsidiaries for the three months ended 31 March, 1951, issued by Dr. John F. Thompson, chairman and president, shows net earnings in terms of U.S. currency of $14,731,390 after all charges, depreciation, depletion, taxes, etc., equivalent after preferred dividends, to 97 c. per share on the common stock.

In the three months ended 31 December, 1950, net earnings were $14,845,506, equal to 98 c. a share on the common and in the first quarter of 1950 net earnings were $8,329,015, or 54 c. a common share.

Radioactive Tracers in Analysis

Discussion by Physical Methods Group of Society of Public Analysts

RADIOCHEMISTRY was the subject of four papers presented and discussed at an ordinary meeting of the Physical Methods Group of the Society of Public Analysts and Other Analytical Chemists, held at the Institute of Physics, London, on 22 May.

In the first paper 'Radioactive Tracer-paper Chromatography Techniques' by F. P. W. Winteringham, F.R.I.C., A. Harrison and R. C. Bridges, it was shown how in conventional undimensional paper partition chromatography the components of a mixture of substances were resolved as a series of spots at characteristic proportional distances along a strip of paper.

When colourless, individual components could be located and sometimes estimated by treating the strip with suitable reagents whereby the spots were rendered visible.

Paper chromatography in many instances was capable of separating substances in amounts below the limits of chemical detection on a paper chromatogram. In other cases the resolving powers of paper chromatography were possibly undiscovered or unexploited because of the lack of suitable chemical methods of detection.

Application of radioactive tracer techniques, to paper chromatography in particular, frequently enabled the separated components not only to be located and characterised, but to be estimated quantitatively. There were three ways of doing this:—

1. Labelling the mixture with one or more radioactive isotopes before chromatography.
2. Treating the paper chromatogram with suitably labelled reagents.
3. Neutron activation of the paper chromatogram; in this case pretreatment of the chromatogram with a suitable non-radioactive reagent would probably be necessary.

Automatic Scanning

In all three cases the final chromatograms were scanned radiometrically and the separated components located and estimated quantitatively. An apparatus for automatically scanning undimensional paper chromatograms radiometrically had been developed and successfully used on a routine basis.

'Paper Chromatography of Radioactive Penicillin' was next described by E. Lester Smith, D.Sc., F.R.I.C., and D. Allison.

Crystalline radioactive penicillin of high specific activity (up to 600 μC. per mgm.) had been prepared from shake flask fermentation of a 'synthetic' medium containing $Na_2{}^{35}SO_4$. Concentrations up to 1 Curie per litre were tolerated by the mould Penicillium chrysogenum Q 176. The proportions of individual penicillins were determined by the technique of Goodall and Levil employing chromatography on buffered paper strips, followed by 'bio-autographic' visualisation of the zones.

Checking the Results

Opportunity had been taken to check the results of radioactivity measurements. The zones corresponding with individual penicillins had been cut from some of the paper strips, radio-autographs being used as guides. Radioactivity in the segments had been measured either by cutting them into squares which were 'counted' individually under a thin end-window Geiger Muller tube, or alternatively by extraction with hot dilute buffer solution, aliquots of these extracts being 'counted' after evaporation of planchettes.

Results by the three methods agreed well. An appreciable proportion of the penicillin appeared to be destroyed after application to the paper strip, as evidenced by a zone of radioactivity at the origin, not associated with antibiotic activity (Reference (1) Goodall, R.R. and Levi, A.A., *Analyst*, 1947, 72, 277).

Application of radioactivation analysis to arsenic determination was discussed in the third paper by A. A. Smales, D.Sc., A.R.I.C., and B. D. Pate, B.Sc.

Advantages for trace estimation were outlined, and the present working limit of the method calculated. The examples of practical analyses which were described included the determination of arsenic down at least to 0.05 p.p.m. in germanium dioxide using less than 0.5 gm. of sample.

A redetermination of the arsenic content of sea-water had been effected, and a determination of the normal

[continued on page 884

Dry Hydrogen Sulphide Recovery

New Continuous Purification Process

by F. G. Audas

IT is believed that the process described in this paper will prove to be a purification system greatly superior to any of the better known methods in current use, and in addition, possess among other advantages, that of giving a by-product of relatively pure sulphur, or, alternatively, liquid sulphur dioxide.

Other methods in common use may briefly be classified under three headings: dry oxidation processes, liquid oxidation processes, and liquid solvent processes. As an example of the first, the iron oxide process has disadvantages which are well known. The plants are large and occupy considerable ground space. They involve the transport and handling of large quantities of oxide and the unpleasant and unhealthy nature of the work frequently causes labour difficulties. Pressure drops through such systems are variable and frequently high. The recovery of sulphur is usually incomplete due to losses in drainage liquors, and in any case sulphur contained by spent oxide must be regarded as an unsatisfactory by-product.

Liquid purification processes, both of the oxidising and solvent type are admittedly often smaller than oxide box systems, but they are usually unable economically to purify gas down to statutory requirements and therefore must frequently work in conjunction with oxide catch boxes. The recovery of sulphur from both types of liquid purification processes, frequently presents difficulties.

Desirable Features

In contra-distinction, the features of an ideal process can approximately be described:

The necessary plant should be small. It should preferably be continuous and automatic to obviate the need for manual work. It should be capable of completely removing hydrogen sulphide so that catch boxes are unnecessary. The need for adding diluents such as air should not arise. Sulphur should be recoverable in a relatively pure form. Finally it is important that capital running and maintenance costs should be reasonably low.

It is believed that the process described in this paper will fulfil all these requirements and in addition it possesses other characteristics which may also be of advantage. It will probably be a twenty-fifth to a thirtieth of the volume of an oxide box system and occupy approximately one-tenth of the ground space.

The Continuous Alumina Process

The process utilizes the reaction of hydrogen sulphide with sulphur dioxide in which the products are water and sulphur:

$$2H_2S + SO_2 \rightarrow 2H_2O + 3S$$

The reaction will take place over a wide range of temperatures but only at low temperatures is it virtually irreversible. In this process the reaction temperature is usually within the range of 30°-90°C., depending on initial hydrogen sulphide and water vapour concentrations. As the concentration of the hydrogen sulphide encountered in coal gas, coke oven gas, water gas, etc., is usually very low, between limits of 0.2-1.5 per cent, then it follows that the reaction rates would also be low and it is therefore necessary to use a catalyst. Many catalysts are known and the commoner ones may be mentioned, as, for example, activated earths, adsorbent carbons, activated alumina, and silica gel. The materials mentioned are all well known as industrial adsorbents, though in other ways possessing widely different characteristics, and for the purposes of this process it is considered that alumina is the most suitable. It is true, however, that for specific gases such as producer gas or blue water gas, active carbons may be superior to alumina, but for general purposes alumina is most suitable.

The removal of hydrogen sulphide from a gas is effected by adding to it sulphur dioxide in small excess of that theoretically required to react with all the hydrogen sulphide contained by the gas and passing the mixture through a bed of alumina chips or granules, at such a rate that it emerges from the chamber containing the bed, completely freed from the hydrogen sulphide.

The reaction products of sulphur and water are deposited on the alumina surface

and in conjunction with the adsorption of other vapours, this causes a temporary loss of activity. In order therefore to maintain high activity in this purifying chamber, the used material is continuously withdrawn from the bottom of the chamber for regenerative treatment, while regenerated material is continuously added at the top. A dual purpose is effected by this continuous withdrawal method in as much as surplus sulphur dioxide (above reaction requirement, as already mentioned), is also carried out of the chamber by adsorption on the alumina and is thus eliminated from the otherwise purified exit gas stream.

The alumina discharging from the purifying chamber contains sulphur, sulphur dioxide, water, and other vapours depending on the type of gas which has been purified. In essence, the regeneration of this alumina consists simply of a heat treatment at approximately 500°C. which expels the sulphur and all other vapours. The method of heating preferred is the passage of hot gases through a bed of alumina contained in a regenerating vessel. The gases may be heated by adding to them the hot products of combustion from an ordinary type of gas burner. It is of advantage to recirculate these gases and also to control the amount of oxygen or air present, so that if necessary all the sulphur vapour may be oxidised to sulphur dioxide, or only part of it as desired. Sulphur dioxide may be recovered to maintain the purifier reaction and also if necessary as a by-product. A limiting of the oxygen content of the gases passing through the bed enables some of the sulphur to be distilled from the alumina unchanged providing an alternative by-product of free sulphur. Though depending somewhat on other conditions, a period of 30-60 minutes at 500°C. is sufficiently long for regeneration.

After a regenerative treatment such as that described above, the alumina is cooled and is ready for further use. It is therefore transferred to a hopper which charges it as required back into the purifying chamber.

Process Adaptable

This process may readily be adapted for the simultaneous recovery of benzol where this is applicable. Benzol is adsorbed on the alumina in the purifier and may be recovered by heating to about 140°C. in a steam coil heated chamber. To do this the plant may simply be modified by the introduction of a desorption vessel between the purifier and the regenerator.

Some reduction in the sulphur content of the benzol recovered from this vessel may be effected by a preliminary purge at somewhat lower temperatures from the preheating part of the chamber. This makes possible the prior expulsion of some of the organic sulphur compounds. Sulphur dioxide contamination of benzol may simply be eliminated by soda ash washing or similar treatment.

Description of Plant

A plant, to purify coal or coke oven gas still containing benzol may be described as follows:

Arranged vertically and in the following order, commencing with the topmost vessel. are an alumina storage hopper, a gas purifier which may be a single or double chamber type, a desorption vessel for the recovery of benzol, a regenerating vessel for restoring the alumina catalyst to its initial activity and also the recovery of sulphur and sulphur dioxide, and finally a cooling vessel from the bottom of which the alumina is led to an elevating pipe, and returned to the hopper at the top of the system, by means of a current of air.

Each vessel bottom is fitted with conical shaped discharge systems containing baffling devices, which deliver the alumina into pipes connected to the top of each subsequent vessel. These pipes being full of alumina, prevent any serious gas leakages from one vessel to another, so long as pressure differences are kept relatively small.

All the vessels in the system may be taken to be full of alumina chips, with the exception of the hopper at the top, where the height of the alumina bed is not important. The alumina moves slowly downwards through the system by simple gravity flow, at a rate which may be controlled by suitably placed valves, until again ready for use, it is returned as already described, back to the hopper by pneumatic elevation.

A pilot plant which embodies most of the features contained in the foregoing description has been tested over a period of several months. The gas treated by the plant was a de-benzolised coke oven gas which normally contained 0.5-0.6 per cent hydrogen

sulphide. No difficulty in the removal of hydrogen sulphide sufficient to satisfy the Gas Referees' lead acetate paper test was experienced and, indeed, exit gas from an almost unattended plant has on occasion been passed through cadmium acetate solution for 24-hour periods without any sign of cadmium sulphide being precipitated. Neither was there any difficulty in the complete and simultaneous removal of the added sulphur dioxide.

Although laboratory work had shown that higher space velocities were possible in the purifier, the plant working range varied between 500 and 1,200 vols. of gas per vol. of alumina per hour (500-1,200 hours^{-1}), the actual gas rates varying between 300 and 700 cu. ft. per hour.

An equivalent oxide box system would be approximately one hundred times greater than this type of purifier.

Other effects of the purifier chamber are to reduce the organic sulphur and cyanogen content of a gas and also to dry it exhaustively. It also appears to remove approximately 0.1 per cent of the olefines contained by a coke oven gas, though it is possible that even this could be recovered. Although pilot plant work has so far been confined to a de-benzolised coke oven gas virtually free from ammonia, naphthalene, tar fog, etc., as well, work on a laboratory unit has made it clear that the continuous nature of the system prevents these from interfering with the removal of hydrogen sulphide.

Referring again to benzol, almost complete removal from a gas containing it may be achieved by adsorption on the alumina in the purifier, simultaneously with the hydrogen sulphide removal. This can be subsequently recovered as already described from the desorption vessel below.

Recovery of Sulphur Dioxide

As already described, to restore the activity of the alumina it is necessary to heat it to approximately 500°C., and this can most easily be done by passing hot gases through the alumina bed. Some sulphur dioxide must always be made for return to the purifier system, and a circulation of heating gases is hence desirable in order to increase its concentration prior to recovery. As already mentioned, restoration of temperature is achieved simply by adding the hot products of combustion from a gas burner to the circulating gases, and an equivalent amount of gas containing sulphur dioxide, carbon dioxide and nitrogen, etc., must be removed and led away to a sulphur dioxide recovery system.

This gas is cooled to condense out most of the water vapour present, and is then passed through a bed of alumina in a small chamber to complete the removal of moisture. The alumina is continuously supplied to this chamber from the hopper, and compared with the rest of the plant only small rates are necessary. The thoroughly dried gas leaving this chamber is passed through a bed of silica gel which removes the sulphur dioxide. Subsequent recovery of sulphur dioxide is achieved by heating with steam coils and partial evacuation. It is then liquefied by compression and air cooling.

Recovery of Sulphur

In the system described above, sulphur may be distilled unchanged from the hot alumina bed by limiting the free oxygen content of the circulating gases. Comparatively crude condensation chambers appear to be capable of almost completely stripping these gases from sulphur fog, which may be collected in either the molten or the solid state. A sample from a condenser chamber on the pilot plant had the following analysis:

	%		%
Moisture ...	2.6	Further L.O.I.	1.1
Sulphur (sol.)	90.5	Fe_2O_3 ...	1.7
Sulphur (insol.)	0.8	Al_2O_3 ...	1.7
Polymer ...	0.4	Undetermined	1.2

The iron contaminating the sample had been leached from certain improvised parts of the equipment made of mild steel. The alumina is dust from the regenerator. With virtually complete elimination of these it is thought that production of a reasonably pure sulphur of low polymer content should not be difficult. This is more or less confirmed by the analysis of a sample of sulphur collected over a period of three months from a laboratory purification plant. After drying at 100°C. it was:

	%
Sulphur (sol.) ...	98.16
Residue (insol. sulphur plus alumina dust)	1.84

For reasons of economy, the recovery of sulphur and sulphur dioxide has been examined qualitatively rather than quantitatively. It is nevertheless fairly certain that

losses of sulphur in either form will be small, and equipment comparatively simple.

Commercial Scale Economics

The alumina used on the pilot plant was the commercial type of activated alumina grade 8/16 B.S.S. It is a fairly pure form of bauxite. It could theoretically lose its activity by a transition to the non-adsorbent and inactive form of corundum. After an approximate running period of about 600 hours however, it was impossible to detect any decrease in plant performance.

Alumina may be lost to the system more directly by attrition of the particles. Other processes mechanically similar, are known to be able to keep dust formed in this way, and hence lost, to figures as low as 0.01 per cent of the circulation rate. For the purposes of arriving at approximate running costs it has been assumed that actual dust losses are four times greater than this.

Making similar generous allowances for gas and steam heating, power consumption, and labour charges, the cost of gas purification by this method approximates to 1.2 pence per 1,000 ft.^{3} This figure takes no account of capital and maintenance charges but neither does it allow for the sale of sulphur or liquid sulphur dioxide, and the advantages of simultaneous recovery of benzol.

Capital costs of full scale units cannot yet be given, but it is known that they would be considerably less than the cost of oxide boxes of similar purifying capacity.

Summary

Although it is difficult to obtain consistent figures for running costs of oxide boxes it is reasonable to say that they are similar. The chief advantages of this process are as follows:

1. The plant volume of approximately one twenty-fifth of an equivalent oxide box system.
2. The reduction of ground space required to about one tenth of an equivalent oxide box system.
3. The recovery of sulphur in a relatively pure form.
4. The alternative by-product of sulphur dioxide which would in some works make the manufacture of sulphuric acid an attractive proposition.
5. It dispenses with manual labour.
6. It effects a general improvement in working conditions.
7. It produces an extremely dry gas. With present trends of gas grid systems involving longer pipe lines at higher pressures, this may well be a matter of growing importance.

Though little has been said here of simultaneous recovery of benzol with gas purification, it may be remarked that with very little alteration in running costs and practically none in equipment, benzol can also be almost completely recovered. Combining sulphur recovery with benzol recovery, the process becomes a reasonably economic one, even for coke ovens, which are not normally greatly concerned with the purification of gas. Benzol recovered should be at least as free from organic sulphur compounds as that from an oil washing plant, and probably somewhat freer.

It is needless to stress the national importance of sulphur recovery at the present time, but it may be pointed out that approximately 60,000 tons per annum are still unrecovered from coke ovens.

Lastly it may be said that this process should be reliable on a full scale and extremely simple to operate. The process is being developed by Audas & Thompson Ltd. of 5 Dunottar Avenue, Eaglescliffe, Co. Durham, under B.P. No. 653,317, of 20 September 1948.

To Increase Copper Output

COPPER production of the smaller mining groups in Chile is to be increased with the help of American credits for equipment and machinery. Assistance in this form, it is said, may reach the sum of U.S. $15 millions and raise production from the present level of 14,000 tons to 40,000 tons per annum. It is also reported that an increase in production by the large copper producers—the Anaconda and Kennecott companies—from their present capacity of 380,000 tons to about 500,000 tons per annum is under consideration. The companies would bear the cost of the expansion, but in compensation Chile would undertake to modify the present taxation system, by giving a better rate than the present 19.37 pesos per dollar for the companies' production costs and by diminishing the taxes on increases in production. On the other hand, the U.S. Senate has now approved the resolution to suspend the tax of 2 cents per lb. on foreign copper.

Increasing Applications of Tin

New Laboratories Opened at Greenford

MUCH valuable work into the uses and applications of tin is carried out by the Tin Research Institute, whose new laboratories at Greenford, Middlesex, were opened by the Duke of Gloucester on Thursday, 31 May.

The institute is the headquarters of the Tin Research and Development Council, an organisation supported and maintained entirely by voluntary contributions from the tin producers of six countries without financial aid in any form from any Government. The council formed in 1932 by Malaya, the Netherlands, Bolivia, the Belgian-Congo, Nigeria and French Indo-China, is the only example of international co-operation of its kind in the world.

Electrochemical Research Laboratory

One of the most important sections is the Electrochemical Research Laboratory where much of the preliminary and exploratory work is done which may ultimately lead to practical processes of tin and tin-alloy plating. Processes for speculum, tin-nickel and tin-zinc originated and are being studied here, and six tin-alloy platings have been invented by the institute.

Among the exhibits in this section was the Hull cell devised so that metal may be deposited at various current densities throughout the length of a single specimen in one operation. Other items included the pioneer tin-nickel plating bath which has been continuously in use for 18 months, and a valve voltmeter designed and constructed in the laboratory to give a direct reading of very small voltage changes.

The Plating Workshop is equipped with full-size plating plant to operate discoveries on an industrial scale. Three methods of tin plating are in use, the sodium stannate, stannous sulphate, and stannous fluoborate baths. Baths for copper and cadmium plating are also available.

Special interest attaches to the new art of tin-alloy deposition, and three processes, invented in the laboratories, were shown. These were: tin-zinc (about 78 per cent tin and 22 per cent zinc); speculum plating, a deposit containing about 40 per cent of tin and 60 per cent of copper); and tin-nickel (about 65 per cent tin and 35 per cent nickel).

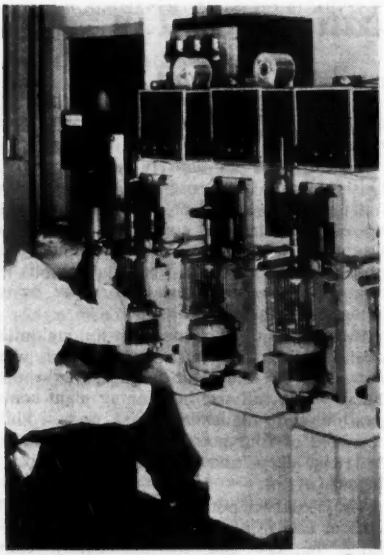
Tin-nickel is an entirely new protective finish, with a faint rose-pink tint. It does not tarnish in or out of doors and requires no cleaning. The coating is deposited bright and requires little or no finishing. The process has not yet been commercially established, but trial installations are being made in various countries.

Full-size equipment for hot-tinning mild steel, cast iron copper and other metals was on view in the Hot-tinning Workshop. There was a full size hot-tinning plant comparable with many industrial units. This consisted of four pots, each 18 in. by 22 in. by 18 in. deep, and each containing about 15 cwt. of tin.

The first two pots were for tinning mild steel or cast iron and were gasfired by neat-flame burners and thermostatically controlled. The third pot contained Palm oil for removing excess tin from dipped articles. The last pot, electrical heated and thermostatically controlled, was for the tinning of non-ferrous metals.

In the Tinplate Laboratory examples were shown of research to improve the manufacturing processes and quality of tinplate. Four methods of measuring the thickness of

Research on tin nickel



Testing bearings for durability under vibration

tin coatings, the Clarke, Bendix, magnet, and Francis tests, were demonstrated.

Freedom from porosity or the degree of continuity is important in the length of service in many applications of tinplate. Three methods of evaluating this quality, the thiocyanate, hot water and moist paper tests were shown.

Preparation of specimens for microscopical examination is important. In the Preparation Room an optically flat surface is produced by a series of polishing operations each so gentle as not to disturb the structure of the metal. Revolving disc machines are now used in place of those formerly operated by hand. Plated specimens pressure mounted in synthetic resin were on view.

Research on the tensile properties, fatigue strength, hardness, etc., of tin and its alloys is conducted in the Mechanical Testing Laboratory. A group of three machines for testing tinplate showed a cupping test, which measures deep drawing quality, a bend test, and superficial hardness test. A new strong pewter containing 90 per cent tin, which is easily worked but can subsequently be heat-treated to give greater strength, hardness, and 'ring', has been developed in the laboratories, as well as a new tin base alloy (88 per cent tin) for under water-bearing which is claimed to be equi-potential with steel in sea water.

Other machines in this section included a Hounsfield balanced impact machine and tensometer; fatigue testing apparatus; a 15-ton tensile and compression testing machine; and a 5,000 lb. tensile testing machine.

In the Analytical Laboratory rapid and accurate analysis can be made of all the metals, alloys and chemicals used in the institute, and few research projects could be brought to a successful conclusion without frequent recourse to its service. The exhibits here were typical of the processes and equipment in regular use.

An interesting item was the analysis of alloys by vacuum distillation. The high boiling point of tin (about 2,260°C.), enables more volatile alloy constituents, such as zinc and cadmium, to be separated quantitatively, by distillation.

Determination of sulphur in bronze had been investigated either gravimetrically or by combustion in oxygen to form sulphur dioxide. A simpler method was by the hydrobromic acid evolution method (similar to the method for sulphur in steel). The sample was dissolved in concentrated hydrobromic acid and sulphur evolved as hydrogen sulphide which was absorbed in an alkaline solution and determined by titration.

Polarographic analysis for detecting and measuring very small quantities of metals in solution, of the order of a few parts per million, and a photoelectric absorptiometer were also on view.

The Main Corrosion Laboratory plays a prominent part in the institute as some of the most important applications of tin and its alloys arise from their high corrosion resistance which has to be tested under a wide range of conditions.

Application of a thin coating of tin (0.00005 in.) to steel before painting has been found greatly to lengthen the life of painted steel. Examples were displayed showing the relative performance of tinned and untinned steel. Methods of assessing the deterioration of paint films near scratches were also shown.

Simulation of a badly polluted industrial atmosphere was obtained by condensation of the vapours above a solution of sulphur dioxide, which rapidly produced evidence

of breaks in a protective coating. Samples under test were steel and brass plated with tin-nickel alloys as compared with chromium over nickel.

By means of the 'Protection' treatment developed at the institute, tinplate can be rendered more resistant to staining when in contact with sulphur-containing foods and also less liable to rust when exposed to the atmosphere. Comparative performance of treated and untreated specimens was demonstrated.

Examples were shown of electro-deposited tin-nickel alloy coatings which have a high degree of resistance to tarnish and corrosion by many common chemicals.

The most satisfactory test is tried in service or under natural conditions and a number of corrosion testing stations are used by the institute. These must of necessity, however, be slow, and accelerated tests have been found necessary for guidance.

In the Corrosion Test Laboratory various environments are simulated in an intensified form and under exact control so that results are repeatable and strictly comparable.

Three chambers used for intensified atmospheric corrosion were on view. Specimens were kept in constant motion and exposed to periods of condensation, or heavy spray, and allowed to dry overnight. Thus some part of the important natural processes of alteration of corrosion products on drying and on being washed with rain were produced.

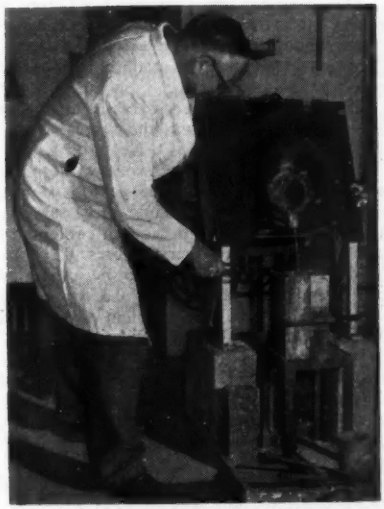
In the tropicalisation test specimens were exposed to a moist hot atmosphere in accordance with a specification (K.110), laid down by the Wireless Telegraphy Board.

Another severe trial was the spraying of specimens daily with salt water from an atomiser and their retention between sprayings in a moist atmosphere. This was in accordance with British Standard 1391.

A small exhibition in which many tin products were shown was displayed in the hall on the first floor outside the office block. A feature of particular interest was a working model of a tin dredge lent by the Malayan Chamber of Mines.

An exhaustive collection of scientific and technical literature on tin is contained in the Information Bureau and Library. The total number of technical booklets distributed by the institute throughout 1950 exceeded 47,000. Two issues of *Tin and Its Uses* were made and the mailing list has grown to over 15,500, although efforts are made to restrict it.

Despite its activities at the Greenford headquarters a number of researches have, for special reasons, to be carried out on behalf of the institute in the laboratories of other scientific organisations.



Casting a bronze cylinder

According to the 1950 report on the work of the institute a theoretical study of the formation of tin alloys is being carried out in the University of Birmingham under the supervision of Professor Raynor.

Investigation of the stability of tin compounds in aqueous solutions has been continued at the University of London under Professor Tompkins.

In the University of Delft the opacifying power of tin oxide in vitreous enamels is being studied under Professor van Nieuwenburg. A considerable amount of time had to be devoted in the early stages to making special equipment, developing technique, and finding means of characterising the different brands of tin oxide available.

Dr. van der Kerk, of Utrecht University, has undertaken an investigation of the preparation and properties of new organo-tin compounds with a view to finding new fields of use for tin compounds.

Radioactive Tracers

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arsenic level of some biological material, such as human hair, nails, blood and urine, and the internal organs of a mouse, had been proved possible with sample weights often little more than a few milligrams.

The working limit for determination in media other than germanium was shown to lie at about 5×10^{-11}g arsenic, with the facilities at present available in this country.

'Microdetermination of Na and K by Activation Analysis,' was the subject of the concluding paper by R. D. Keynes, M.A.

In the course of some work with radioactive tracers on the exchange ions during nervous activity, it became necessary to know the sodium and potassium contents of isolated cephalopod nerve fibres 0.2 mm. in diameter, the amounts to be estimated being sometimes as little as 0.3 μg. of Na and 3 μg. of K. The problem was solved by using the technique of activation analysis. In principle this involved irradiating tissue samples with neutrons, and then determining the quantities of the various radioactive isotopes formed, as a measure on the amounts of the parent elements present in the samples.

In most applications of the method, the activities of the different isotopes were estimated after adding inactive carriers to the irradiated samples and then separating the elements under investigation by conventional chemical procedures. For animal tissues it happens that the isotopes Na^{24}, K^{42}, P^{32}, and S^{35} are formed in much greater quantities than any others, and these could be determined by taking advantage of their widely differing radiation characteristics and half-lives, without any chemical treatment of the samples.

Analytical procedure, therefore, consisted in first irradiating the samples (each sealed in a small quartz tube) for a week in the Harwell neutron pile, together with standard samples of spectroscopically pure Na_2CO_3 and $KHCO_3$, and then transferring them to nickel dishes and taking two counts, one with a very thick filter between sample and Geiger tube to obtain the α-count from Na^{24}, and the other with a thinner filter to obtain the β-count for the exceptionally strong β-radiation emitted by K^{42}. A small correction was necessary for the β-count due to P^{32}, which could easily be measured after the short-lived isotopes had been allowed to decay.

An alternative method of estimating the K^{42} by adding inactive K_2CO_3 as a carrier, precipitating potassium as the dipicrylaminate, and taking counts in a liquid counter, had also been worked out, and might be valuable in handling samples containing relatively more Na and less K than nerve and muscle tissue.

No special apparatus was needed other than the usual equipment for measuring radio-activity. The standard error of the results was of the order of ± 2 per cent. and the method could without much difficulty be used to estimate quantities of Na down to 0.05 g.

Dried Sludge Fertiliser

THE first sewage plant of its type in Scotland, producing a dried sludge fertiliser, has been opened by the Burgh of Barrhead. This new plant uses the Porteous system of sludge treatment and produces dried blocks of 24 in. square by 1½ in. thick. These blocks can be used either as a fertiliser or as a fuel. Speaking at the recent opening, the Under Secretary of State for Scotland, Mr. Tom Fraser, urged municipalities in Scotland to consider recovery of sewage solids and looked forward to the day when all such solids would be returned to the land. He deplored the continued loss of solids through antiquated sewage disposal methods and anticipated that the Bill now before Parliament would assist in making obligatory the use of solids in the better way, by returning them to the land as a fertiliser.

British Plastics Year Book

The British Plastics Year Book has just been published by Iliffe & Sons, Ltd. It contains the usual ten sections dealing with technical data, associations and federations, who's who, names and addresses of firms, organisations, etc., a glossary section, plant and equipment and products sections, etc., together with a review of patents in all fields of plastics, and a section on materials used and produced in the plastics industry. This is an indispensable book for those connected in any way with the plastics industry. The 21st edition, the 1951 Year Book consists of 434 pages and sells for 30s. net.

Instruments for Chemical Plant

Part II—Composition Analysis

THE rapid development of continuous chemical processes has brought in its stride new applications of direct and quantitative methods of composition analysis. Gases, liquids or solids can now be analysed and their composition ascertained by instruments which give immediate results in accurate and reliable form. These methods use characteristic properties pertaining to the atom, the molecule or the crystal structure of the substance. Characteristics such as thermal conductivity, specific gravity, etc., are not positive enough for use, because they are not exclusive to any one substance, but they are nevertheless very useful properties to know during processing. Measurement of ion concentration, and of the automatic control of *p*H has become widely used, and so has measurement and control of moisture in gases, fluids and solids.

Spectroscopic Instruments

Spectroscopy affords at the present time one of the best methods of measuring and controlling the quality of some manufactured materials. By identifying atomic and molecular spectra, the basic properties of a material can be ascertained at a single glance, and without delay.

Space does not permit going deeper into the intricacies of absorption spectroscopy and infra-red techniques, of emission-spectroscopy and mass spectroscopy, all of which are still in the most vigorous development for practical industrial purposes.

Good practical progress has been made in the analysis of solids with X-ray spectrometers, especially in crystalline and morphous materials where the atoms of each element lie in regular spacings, and X-ray diffraction can help production men to watch process quality unfailingly. The uses to which X-ray spectrometers have been put in practice range from control of cement manufacture to powder and stability of metal alloys, including the effects of heat treatment. Such diverse operations as calcining of lime (to ensure freedom from carbonate), and age-hardening of castings can be analysed.

In America, a combination of the Geiger-Counter X-ray Spectrometer with the Brown Elektronic Potentiometer Strip chart recorder has played an important part in development, and in consequence the North American Philips research and development group have designed a reliable apparatus for practical industrial use.

In an industrial spectrometer the diffraction cone is scanned by rotating the counter tube across the cone. An electronic amplifier is used, and beam intensity versus dimensional spacing is recorded on a Brown Potentiometer Recorder, actuated from impulses.

Gas Analysis Apparatus

One of the most widely used applications of the thermal conductivity measurement of mixtures of gases is in the carbon dioxide recorder for combustion control of steam boilers and industrial furnaces. A recently developed instrument of this type produces three records in a single strip chart, as shown in Fig. 1—namely, gas temperature, $CO + H_2$, and CO_2.

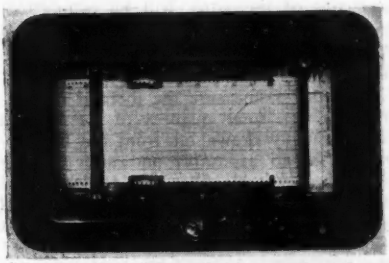


Fig. 1.—$CO + H_2$ and CO_2 analysed and recorded on modern Strip Chart Recorder *(Courtesy of Kelvin & Hughes, Ltd.)*

Great efforts are being made, partly by the makers of instruments, partly their large users in the chemical field, to develop automatic gas analysers and controllers, as in the control of the oxygen content of gas mixtures, etc. Experimental installations are already in use, but the instruments seen by the writer seem very elaborate and costly. It is hoped, however, that automatic gas analysers and controllers for various processes will be available in simplified form, using electronics and magnetic and electric fields, in the years to come.

It might be of interest to look into the simplest method of electrical flue gas analysis for boiler or furnace flue gases, in order to visualise possible future developments in general gas analysis. As an example of a practical and reliable flue gas analyser the well-known Elliott instrument has been chosen, which is typical of the method which compares the electrical conductivity of gases. In this instance air is the second gas.

The principle of the electrical CO_2 Meter depends on the fact that the thermal conductivity of CO_2 is much less than that of the other gases normally present in the flues (*i.e.*, nitrogen, oxygen, carbon monoxide and water vapour). The following are comparative values of the thermal conductivity of these gases, that of air being taken as a standard at 100.

Water vapour	...	130
Oxygen	...	101
Nitrogen	...	100
Carbon monoxide	...	96
Carbon dioxide	...	59

If any appreciable amount of CO_2 is present in the flue gases, the thermal conductivity of the latter will be proportionately reduced, and this reduction will be an accurate measure of the percentage of CO_2 present.

In order to measure the thermal conductivity, a very small quantity of the flue gas is continually drawn off from the flues by means of an aspirator, and after passing through a suitable filter and cooler, is led through a metal tube about 4 in. long and about ¼-in. in diameter. A fine platinum wire is stretched along the central axis of the tube and is warmed by an electric current, its temperature depending on (a) the magnitude of the heating current, and (b) the thermal conductivity of the flue gas surrounding it. The wire actually loses heat through the flue gas in three ways, (1) by radiation, (2) by convection, and (3) by conduction.

The heating current and consequently the temperature of the wire, are intentionally kept at a comparatively low figure (about 100°C.), so that the radiation is inappreciable; and in a tube of such a small diameter, convection currents are almost entirely absent.

It therefore follows that, provided the heating current is constant, the temperature of the wire will depend entirely on the thermal conductivity of the flue gas. Now the electrical resistance of the wire is proportional to its temperature, so that if this resistance is measured by a 'Wheatstone Bridge' the bridge galvanometer can be calibrated directly in percentage of CO_2.

This instrument is made absolutely independent of fluctuations of temperature in the boiler house by fitting a duplicate wire and tube, through which air is drawn instead of flue gas, and connecting it to the opposite arm of the bridge to which the flue gas tube is connected. By this means, the difference between the resistances of the two wires is measured and this depends solely on the thermal conductivity of the flue gases. In order to make the bridge as sensitive as possible, both the air and the flue gas tubes are duplicated and are connected up so as to form the four arms of the bridge.

The gas chambers and air chambers are drilled in heavy metal blocks to ensure they are all at the same steady temperature, and by arranging the actual measuring chambers as a shunt to the main gas and air flow channels, the readings are practically independent of small variations of velocity of gas flow. The analysing unit is mounted in a metal case which also contains fuses, terminals, bridge current indicator and adjusting knobs. The right-hand knob controls a rheostat by which the bridge current may be set to the value indicated by a red line in the small indicator above. The left-hand knob is for setting the CO_2 readings to zero before starting up the apparatus, by equalising the arms of the bridge while drawing air through both the gas and air chambers.

The CO + H_2 Meter resembles the CO_2 meter in some respects, but differs entirely in principle. It depends on the heat generated when CO and H_2, the unburnt components of the flue gases—are burnt in air to form CO_2 and H_2O.

The gas sample, after passing through the CO_2 meter, is mixed with sufficient air for complete combustion and then flows through a metal tube containing a resistance wire. This wire is maintained at a temperature of about 450°C., at which it acts as a catalyst, enabling the CO and H_2 to ignite at temperatures below their normal 'flash points'. This reaction is exothermic, that is to say,

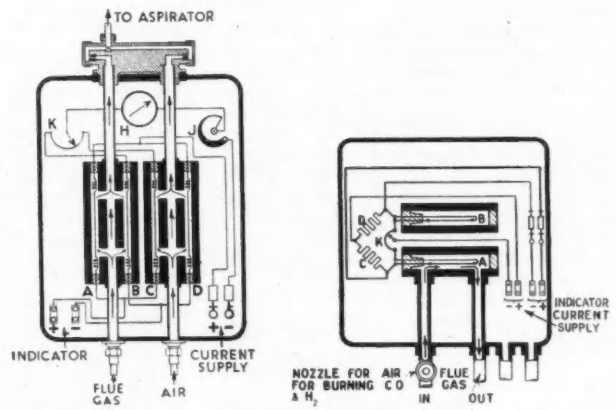


Fig. 2. — Sectional diagrams of Elliott CO_2 and $CO + H_2$ transmitters

it causes heat to be liberated, and as a result the wire is still further heated, its consequent rise in resistance being a measure of the unburnt gases present in the sample.

The heated wire forms part of a Wheatstone bridge, a duplicate wire being provided in the comparison air chamber (Fig. 2). The analysing unit is mounted in a metal case which also contains terminals, zero adjusting knob and air inlet nozzle. The dimensions of the gas chamber are such that the normal gas velocity for the CO_2 transmitter is also correct for the $CO + H_2$ meter. Where the flue gases are at a temperature below 200°C (or 400°F.) an external filter is used instead. The combined aspirator and cooler is of tubular construction. Cold water enters the main body of the aspirator and in flowing through the inner tube (A) aspirates the gases from the analysing units. The gases are drawn from the flue and pass up a tube (B) surrounded by the cooling water. Air is also drawn at the same time up a similar tube (C). Gas and air then pass on to the transmitters, but any excess of aspiration due to variations of chimney draught or water supply is released by bubbling through the liquid in the glass container at the top (D), thus enabling aspiration to be continuously observed. The advantages of this construction are independence of head of water supply, independence of chimney draught, and the fact that gas and air are both brought to the same temperature and humidity.

The current supply necessary for the CO_2 meter is approximately 1 amp., both being at 6 volts D.C.

Moisture in Gases

Humidity measurement of air is very important for the air conditioning of workshops, storage and package rooms, etc., and, also, certain chemical processes require the drying of gases. The well-known dry and wet bulb method of doing this, or measuring the 'psychrometric difference' or 'wet bulb' depression has been used for developing sturdy and reliable industrial humidity meters and controllers. A modern electrically operated humidity transmitter is shown in Fig. 3. The instrument consists of two

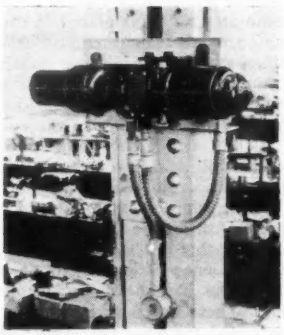


Fig. 3.— Elliott Humidity Transmitter *(Courtesy Elliott Bros. (London) Ltd.)*

dry-bulb resistance thermometers, and one wet bulb. Air is continuously drawn over the bulbs by means of a motor-driven built-in fan in the instrument housing. The

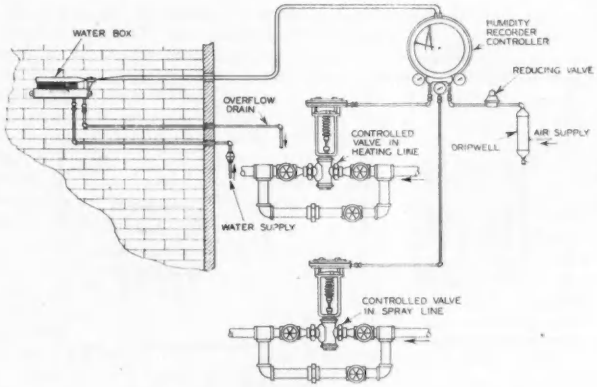


Fig. 4.—Installation layout of Wet and Dry Bulb Humidity Controller *(Courtesy Foxboro Co., Inc.)*

psychrometric difference (wet bulb depression) is telemetered to the receiving instrument, which can be an indicator or a strip chart recorder. An instrument panel for measurement of humidity and CO_2 content of storage rooms reveals at a glance atmospheric conditions.

Central control of air conditioning is recently more and more performed from control panels, which incorporate all the instruments for measurement and automatic control. The many applications of the hot air drying of chemical solids often requires closely controlled temperatures and humidity conditions. A pneumatically operated temperature-humidity controller is shown serving a drying kiln, and Fig. 4 illustrates the layout of the control system. A wet and dry bulb attachment is placed in the conditioned space, and a dual controller actuates one diaphragm valve in the heating line, and another control valve for admission of spray water if humidity drops below the desired value.

Other arrangements on chemical dryers use diaphragm lever motors for operating air dampers for recirculation of the air, thus keeping the air humidity as desired. A great future for providing controlled air conditions for chemicals, or for improving the efficiency of inadequate drying rooms or apparatus lies ahead for chemical dryers of air. These use adsorbent materials such as activated alumina, etc. Fig. 5 shows a dual type Lectrodryer for the drying of air piped under pressure. The apparatus shown is designed for drying 200 cu. metres of free air per hour at 100 p.s.i. to a moisture content equivalent to saturation at $-20°$ F. Electric heaters for re-activation in the form of low voltage elements which also form water-cooling passages keep down the temperature of the adsorbent material during operation. Controlled humidity of the air is thus achieved, and it is also possible to dry gases used in chemical manufacture to the desired humidity content. Although improvements have been made in wet and dry bulb controllers for air humidity, their use is limited to relatively moderate air temperatures due to the use of the moist wick. The

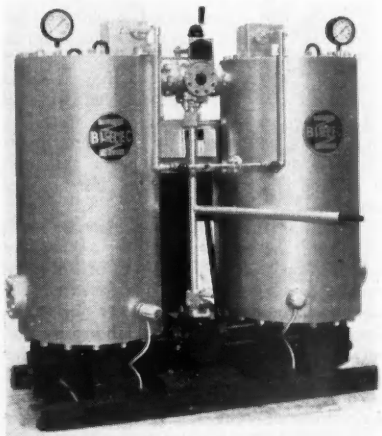


Fig. 5.—Dual type Lectrodryer with electrical reactivation *(Courtesy Birlec Ltd.)*

problem of manufacture of simple humidity controllers for higher warm air temperatures still remains to be solved.

The demand for an automatic Dewpoint Hygrometer for industrial purposes has led to the recent development of an interesting, although somewhat elaborate instrument, using photocells and a special D.C. amplifier. The industrial Elliott Dewpoint Hygrometer has a continuously running refrigerator, which cools a copper block, and a small aluminium thimble connected to the copper block is cooled by conduction. The top surface of the thimble is highly polished and illuminated obliquely by a lamp and lens system. The air or gas under test is directed across the thimble top, by means of a jet, and as soon as the thimble is cooled to the dew or frost point of the gas, a deposit forms on the surface. A photocell views the thimble top through another lens system and only detects the scattered light from the surface. A second photo-cell is illuminated directly from the lamp through an adjustable aperture (Fig. 6).

The output from the two photocells is amplified by a differential D.C. amplifier consisting of a single stage double triode thermionic valve. The output from this valve is connected to a magnetic amplifier, which in turn controls the current in a heater coil wound directly on to the outer wall of the thimble. Thus the temperature of the thimble is controlled, with a light deposit on the surface, to the dew or frost point of the gas. The temperature is measured with thermocouples embedded in the thimble just below its top surface. The reference couples are maintained at a constant temperature in an oil bath, and the thermocouple output is amplified by a magnetic amplifier operating an indicator and recorder calibrated in degrees centigrade. Both these instruments have a full scale deflection of 5mA.

The design follows work by Brewer, Dobson and Cwiling ('Measurement of the absolute humidity of extremely dry air.' *Proc. Physical Society*, January 1948), and its essential parts works as follows:

The refrigerator Freon gas is compressed by a two-stage pump driven by a single phase 240 volt, ½ h.p. motor. The compressed gas is cooled in an evaporator unit consisting of a copper block lagged in a cork box. The copper block is thus cooled to −50° C., and thermal contact is made with the aluminium thimble through a copper stem. The Hygrometer Optical Unit contains the aluminium thimble, lamp and lens system, and the two photo multiplier tubes. The gas under test is directed over the surface of the thimble by a jet, and is drawn

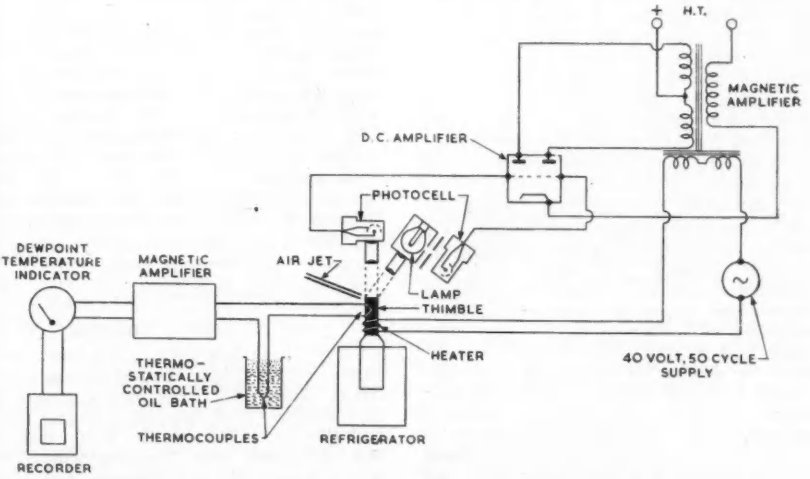


Fig. 6.—Working diagram of new Elliott Industrial Dewpoint Hygromet er
(Courtesy Elliott Bros. (London) Ltd.)

through the unit by a small fan driven by an electric motor. Indication of flow is shown on a U-tube manometer. The Hygrometer Amplifier amplifies the output from the two photocells, and contains a single stage D.C. amplifier, driving a magnetic amplifier, which in turn controls the current through a heater winding on the thimble.

The Power Unit provides the stabilised E.H.T. supply for the photo-multipliers and the power supply for valve heaters, etc., and the magnetic amplifier in the hygrometer amplifier. The temperature reference bath is a lagged box maintained at a constant temperature for the cold junction reference temperature of the thermocouples. The thermocouples Magnetic Amplifier amplifies the output from the thermocouples and operates the indicator and recorder connected in series. All the units can be removed individually, for servicing, and interconnections are made with cables and sockets which fit plugs mounted on the units.

The range of dew points which this instrument can measure is from $-40°$ C. to $+20°$ C., with an accuracy of $\pm\frac{1}{2}°$ C. and a time response of about two seconds. Any non-corrosive gases may be passed through the instrument, and a dust filter can readily be fitted, if the dust content of the gas under test is high. It is important that the gas should be dust-free before it is passed over the thimble surface. The instrument can also be used with gases that are above or below atmospheric pressure, within the limits of +20 in. water gauge. Continuous running of the refrigerator unit makes the hygrometer suitable for 24 hours-a-day operation. The recorder can be removed from the cabinet, if it is required to mount it separately.

It should be mentioned that during the last years various new instruments have been developed for the measurement of the moisture content of solid materials. Moisture meters are available to determine the moisture content of powdery or granular materials, of timber, of textile yarn after sizing and of paper, etc. Space does not allow the description of these in detail, but it may be stated that further developments seem necessary to produce humidity measuring and controlling instruments for chemical solids during continuous processing. Such future developments may one day bring, for example, the solution of the problem of measuring the moisture content of a powdery or granular chemical processed in a continuous multi-zone conveyor dryer, first at the point of entering the first zone, then in each drying zone, and finally when leaving the hot air dryer. The present method of automatic control of humidity and temperature uses the air in each zone as the substance to be controlled, which is not the same thing at all as using the material to be dried as such, during processing.

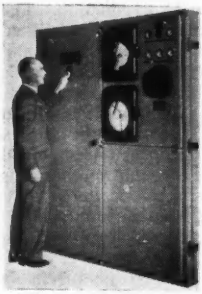


Fig. 7.—Outside view of Climatic Test Cabinet with Fulscope Time Cycle Controller
(Courtesy Air Control Installations Ltd.)

An interesting test cabinet for subjecting chemicals to all sorts of climatic tests under freezing or tropical conditions, and also under imitated barometric changes has been developed, and is illustrated in Fig. 7. It contains a refrigeration unit, a heating unit, a motor-driven fan, heating and cooling elements, and air-mixing dampers. A predetermined cycle of events can be automatically maintained, and repeated if desired. Fig. 7 shows a Fulscope Programme Controller fitted on the outside of the climatic test cabinet. The upper cam instrument contains a cam which has been cut by the user in order to reproduce exactly the time curve for the controlled factor, whatever it is.

(To be continued)

Private Limited Company

J. F. Marfarlan & Co. has been converted into a private limited company as from 1 June, 1951. The new company is now entitled: J. F. Marfarlan & Co., Ltd., and the directors are: D. Rainy Brown, B.A. (chairman and joint managing), N. Rainy Brown (deputy chairman and joint managing), R. H. Mathew and F. J. Bolton, B.Sc., F.R.I.C.

Standardisation in the Chemical Industry

FIFTY years ago a London iron and steel merchant, Mr. H. J. Skelton, suggested that far-reaching benefits might be achieved by reducing the unlimited variety of iron and steel sections to a carefully framed list of agreed standards covering all requirements. His proposal was vigorously supported by the famous engineer, Sir John Wolfe Barry, K.C.B., then president of the Institution of Civil Engineers. The movement met with an encouraging response and a meeting held in February, 1901, resulted in the formation of an Engineering Standards Committee.

Thus originated the British Standards Institution, whose Golden Jubilee will be celebrated this year by an exhibition at which the contemporary benefits of standards, standardisation and simplification will be graphically represented. This exhibition will be staged at the Science Museum, South Kensington, London, from June 18 to 28, and over fifty major industries using the BSI's services will take part. The international affiliations and influence of this great British institution will be marked by the presence in London during Jubilee Week of the presidents and directors of the national standards bodies of more than thirty Commonwealth and foreign countries.

Originally the scope of the Engineering Standards Committee was confined to steel sections for constructional and similar purposes; its first achievement being the reduction in the number of sizes of structural steel from 175 to 113. Examination of other engineering products followed, with equally striking results. As time went on the benefits resulting from intelligent standardisation in the engineering field were so obvious that other industries began to ask for standards to be developed.

Main Industrial Groups

To-day the British Standards Institution, with its scope formally embodied in a Royal Charter, serves four main industrial groups —engineering, chemical, building and textiles—with sectional committees to cover special fields. The work of standardisation is carried out mainly by Industry Standards Committees, each one representative of the manufacturers, distributors, users and professional bodies associated with that particular industry. At present there are 54 Industry Standards Committee and no fewer than 2,100 technical and sub-committees. Over 2,000 meetings and conferences are held each year.

The institution is entirely a voluntary body, formed and maintained by industry with the co-operation and support of the British Government. Its success is ascribed to two main factors. In the first place, the procedure adopted ensures that only standardisation demanded by both producers and users is carried out. Secondly, standards are prepared by agreement and accepted by all the interests concerned, so that they are assured of general adoption before being issued.

Twenty Chemical Committees

Of the 56 Industry Standards Committees approximately 20 are concerned either with the products of the chemical industry or with specialised materials used by chemical manufacturers. There are industry committees dealing with both heavy and fine chemicals. Both these committees have issued and are preparing standards governing the qualities of the end products coming within their scope. A Chemical Engineering Industry Committee is concerned with specifications for materials covering the special requirements of the industry. A separate industry committee is working on materials which are suitable for use in the petroleum industry. In addition, several other committees deal with particular groups of products such as plastics, rubber, adhesives, oils and fats, and tar products.

The list of British standards covers a wide range of coal derivatives such as benzoles, creosote, xyloles, phenol, toluoles, etc. In the adhesives field standards have been issued for various forms of glue, of both natural and synthetic origin. British standards for oils and fats cover many fish oils for different industrial applications, as well as such products as liquid toilet soap. A considerable amount of work has also been done on petroleum derivatives such as fuels for oil

engines and turbine oils. Certain wood preservatives are covered by British standards, while another series of standards deals with chemicals for electroplating. Many alcohols and esters are included in an extensive range of standards for organic solvents and allied products.

Many of the standards issued deal not with quality, but with the methods of testing used in the laboratory as a means of assessing quality. While most of the quality standards are associated with methods of test, some standards are concerned only with methods of test. Examples of the latter type are a comprehensive standard for methods of analysis of oils and fats and another one, equally comprehensive, which specifies methods of testing vulcanised rubber.

Laboratory Glassware

Of great importance to the chemical industry are the sections relating to laboratory glassware and scientific apparatus. Most of the volumetric and general glassware normally used in chemical laboratories is covered by British standards, while much of the past and present work of the Instrument Section is also of direct value to chemical manufacturers. Codes on temperature measurement and flow measurement have already been issued. Work is proceeding on the standardisation of various types of industrial instruments.

Another direction in which the BSI is assisting the chemical industry is by the preparation of standards relating to raw materials such as coal. This work does not come under the Chemical Divisional Council, but is carried out by the Solid Fuel Industry Standards Committee, which is affiliated to the Engineering Divisional Council. Standards defining methods of analysis for coal and coke have been published, as well as codes for testing the efficiency of boiler installations, steam generating plant, and similar installations.

The attention accorded to specialised requirements of the chemical industry is well exemplified by the recent issue of a provisional code for the design of fusion-welded pressure vessels. This code is intended to cover the design of vessels used under all pressure conditions in the chemical industry. Comments and suggestions for amendments were invited from members of the industry and work on the preparation of a final code is under way. In connection with this code it has been necessary to specify certain steels used in pressure vessels, bearing in mind the varying temperature conditions which they are required to withstand. Corrosion resistance is another factor which is sometimes important when specifying steels for pressure vessels.

Certain needs of the chemical industry are covered by other committees operating under the Chemical Division. The Rubber Committee, for example, is responsible for such items as rubber conveyor belts and rubber hose. Another section is working on protective clothing and gives due attention to such special requirements of the chemical industry as acid resistant clothing. A Photographic Section is concerned with the standardisation of different sizes of photographic paper and also deals with X-ray film, as well as with certain special apparatus used for X-ray examination of materials. Many of the ingredients of paints have been standardised and a standard has been issued for ready-mixed paint. Work has also been done on standardisation of the quality of gas cylinders for many types of gas.

Of interest to chemical engineers are the many standards relating to drawing office materials, such as nomenclature of drawing instruments and symbols for valves and pipe lines, flow meters, temperature and pressure points, etc. The chemical industry is also benefiting from the institution's packaging code and from the specifications controlling packing materials and containers such as Winchester bottles, carboys, etc. Bearing in mind that there is hardly an item in the plant and equipment of chemical factories which is not specified according to standards issued under the Chemical Divisional Council or by the mechanical engineering, steel or non-ferrous sections, it may fairly be stated that the British Standards Institution is associated with every aspect of chemical manufacture, from the purchase of machinery and raw materials to the inspection and dispatch of the manufactured products.

Emergency Specifications

As a means of conserving materials it became necessary during the war to issue several specifications dealing with products of an emergency character. Now that conditions of scarcity have returned, appropriate committees of the institution are considering the existing shortages of certain metals and

their effects on national standards. Authority has also been received from the Heavy Chemical Industry Standards Committee to proceed with work on the standardisation of the different grades of sulphuric acid.

To assist the chemical industry a committee representative of both the fine and heavy sides is working on a recommended nomenclature for chemicals. Nine grades of sulphuric acid, for instance, are known in industry by as many as 70 different names. It is hoped that these can be reduced to a single recommended name for each grade. Similar work is being done on a comprehensive series of other materials.

Standardising Names

In close liaison with Commonwealth countries and the United States, the institution is endeavouring to standardise coined common names for the numerous pest control products, the true chemical names of which are often monstrosities. One of the newer insecticides, for example, is referred to in scientific literature by 11 different permutations and combinations of chemical terminology, a typical name being bisdimethylaminophosphonous anhydride. The institution has recommended that this product should be named 'Schradan' after the German scientist Schrader, who pioneered it, and this name is already being used by the trade. It is hoped that the first list of recommended names for pest control products will soon be published.

A glossary of terms used in the plastics industry will be published in the near future. This is regarded as a very important contribution, because it is hoped that it will not only be used in the United Kingdom but will also be considered by the International Organisation for Standardisation as a possible basis for terminology in its work on plastics.

A new project which directly concerns chemical manufacturers both as producers and as users is the formation of a committee to prepare a comprehensive series of tests for the chemical analysis and physical examination of water. A committee already in existence is working on comprehensive standard methods for boiler water tests, which are intended to serve as a basis for different user industries.

Through the British Standards Institution Britain is represented on the International Organisation for Standardisation (known as ISO), which has a small headquarters staff at Geneva. ISO was set up by the United Nations and is affiliated to UNO. It works in complete liaison with other international bodies (for example, the International Union of Pure and Applied Chemistry), and considers any projects for standardisation which are submitted to it by these bodies. About thirty nations are represented on ISO.

ISO's normal practice is to set up technical committees to deal with different subjects on an international basis. The British Standards Institution has been appointed to undertake the secretarial work for several committees, including those dealing with rubber, laboratory glassware, and glass cylinders. It is also participating in ISO committees dealing with paper, raw materials for paints, photography, plastics, concrete, chemistry, and materials used in the petroleum industry.

When it is decided that the United Kingdom should participate in the work of an ISO technical committee, a national committee is formed which consists of completely authoritative representatives from the industry concerned. The British Standards Institution then acts as organising agency for the committee's meetings and as the channel through which the discussions and recommendations made can be put to the appropriate ISO committee. These committees meet at intervals of perhaps a year and the United Kingdom is represented by a delegation consisting of members of the industry who are expert in the particular matters under discussion.

In general, the method of international approach is for representative teams to consider first terminology, then methods of test, and finally—when methods of test have been agreed—standards of quality are examined.

It is scarcely necessary to stress the value of United Kingdom participation in the work of these committees, particularly at present when the export drive is an all-important feature in the national economy.

Huge Expansion Programme

The Dow Chemical Company, Midland, Mich., plans to spend $100,000,000 on a company-wide expansion programme in its next fiscal year, which began on 1 June, the firm's president announced recently. Half the amount will go towards the expansion of the Texas division at Freeport.

· PERSONAL ·

Follsain-Wycliffe Foundries, Ltd., and Varatio-Strateline Gears, Ltd., announce that MR. T. R. TAYLOR, of 51 Netherpark Avenue, Netherlee, Glasgow, S.4 (telephone number Merrylee 4213), has been appointed their Scottish representative.

The KING OF SWEDEN was elected an honorary member of the Linnean Society at its anniversary meeting held recently in London. The Linnean gold medal was awarded to DR. THEODOR MORTENSEN, of Copenhagen, and accepted on his behalf by the Counsellor of the Danish Embassy. PROFESSOR F. E. FRITSCH was elected president for 1951-52.

Thomas Tyrer & Co., Ltd., Stirling Chemical Works, London, E.15, have announced that MR. W. TURCAN retired on 31 May. Mr. Turcan has been managing director for the past nine years but his association with Thomas Tyrer & Co., extends over a period of almost half a century.

He is succeeded by MR. A. W. R. CHANDLER and DR. J. S. PEDDER, who will occupy the position of joint managing directors.

MR. RICHARD CLEMENTS, who for the past three years has been Press and Public Relations Officer for Exide and its associated companies, is giving up this position from the end of June. Mr. Clements was formerly editor of THE CHEMICAL AGE and science correspondent of the *Daily Mirror*. He will not, however, be cutting himself off altogether from journalism as he is to work on a new edition of Tilden's 'Chemical Discovery and Invention in the Twentieth Century.'

The Industrial Pest Control Association has announced that the following officers have been chosen for the year 1951-52:—

President, S. W. HEDGCOCK, Chelsea Insecticides, Ltd.; vice-president, DUNCAN R. LEITCH, Ratsouris, Ltd.; hon. treasurer, S. F. SPRANGE, The London Fumigation Co., Ltd.; hon. auditors, C. L. CLAREMONT, Rodent & Insect Pest Destruction Co., and G. P. POLLARD, Petrochemicals, Ltd.

The Executive Committee will consist of MESSRS. T. A. ACTON (Pesticidal Services (Ireland), Ltd.), G. A. EMERY (The Murphy Chemical Co., Ltd.), K. F. GOODWIN-BAILEY (Cooper McDougall & Robertson, Ltd.), L. F. HUNT (Shell Chemicals, Ltd.), C. STUART KREGOR (W. Edmonds & Co., Ltd.), and DR. F. P. COYNE (ex-officio) (Imperial Chemical Industries, Ltd.).

MR. W. A. WILLIAMS, M.B.E., B.Sc., will continue as secretary.

MR. S. C. TYRRELL, F.C.W.A., F.I.I.A., local board director and chief accountant of Newton Chambers & Co., Ltd., Sheffield ironfounders, engineers and chemical manufacturers, was elected president-designate of the Institute of Cost and Works Accountants at the annual general meeting which took place recently at the Dorchester Hotel, London.

The management of Bayer Products Ltd., has appointed MR. L. M. SPALTON, B.Pharm., M.P.S., to the Board of Directors, effective from 1 June. Mr. Spalton will, as heretofore, continue to supervise the pharmaceutical and veterinary sales in Great Britain and Eire.

New Sulphur Dioxide Plant

CANADIAN Industries, Ltd., has announced it will erect a new plant at Copper Cliff, Ont., to produce liquid sulphur dioxide from by-product gases arising from the operation of the oxygen flash smelting process recently developed by the International Nickel Company.

The plant has been made possible as a result of extensive research and exploration by C.I.L., and Inco, directed towards the commercial utilisation of waste fumes from the giant smelter. When the new plant is in operation it is expected to produce in the neighbourhood of 90,000 tons of liquid sulphur dioxide per year.

Liquid sulphur dioxide is not made in Canada at the present time although C.I.L. produced it in relatively small quantities from 1932 to 1945. Supplies are now obtained from the U.S.A. but consumption is small due to its high cost.

The Chemist's Bookshelf

SYSTEMATIC ORGANIC CHEMISTRY. 4th Edition. By W. H. Cumming, I. V. Hopper and T. S. Wheeler. Constable & Co., Ltd., London. Pp. 556. 37s. 6d.

More than a generation of chemists has passed from student to lecturer, research worker or industrial chemist since this book was first published, and many of our present-day professors and even Fellows of the Royal Society were students when the first edition appeared in 1923. It is a silent tribute to the vitality of this student's textbook that to-day, in the age of paper shortages and restrictions, the publishers have felt justified in bringing out a fourth edition. It is interesting to speculate why this should be so and why this book has survived when so many others have perished. One of the reasons must lie in the authors' arrangement of the subject matter, which probably novel in 1923, has had the compliment of imitation by other writers notably among the Americans. This style was a reaction from the 'Mrs. Beeton's' type of presentation in laboratory textbooks and though far from easy to follow at first glance, had the merit of developing the 'research mentality' and of providing a direct extension of theoretical chemistry in laboratory practice.

Other contributory factors were the sections on the use of the library, costing and the use of apparatus. In the present edition the authors have made a number of additions and alterations. The section dealing with analysis now contains a description of the micro-methods of determination of carbon and hydrogen, the halogens and sulphur in place of the semi-micro and macro methods previously included. This appears to be a questionable step since the micro technique is a somewhat lengthy one to acquire and it is unlikely that the student will find time to fit a course into his already overcrowded timetable. On the other hand the sections dealing with distillation under reduced pressure and fractionation seemed to be unduly curtailed. These are invaluable techniques which are used continually and a description of the use of motor and diffusion pumps would have been welcome. The section dealing with chromatography was also very short, being less than one page, and was not particularly helpful. The chemical section, however, has been brought up-to-date in a complete and comprehensive manner the only serious omission being the reactions of acetylenic compounds.—J.R.M.

A TEXT BOOK OF PHYSICAL CHEMISTRY. By Sylvanus J. Smith. Second Edition. MacMillan and Co., Ltd., London. Pp. 354. 9s. 6d.

This text book, which is a new edition of one first published in 1936, is primarily intended to cover the ground required for the Higher School Certificate Examination and might, therefore, have been better described as an *introduction* to physical chemistry. In order to remain abreast of modern advances new sections have been added on the quantum theory, chain reactions and complete dissociation. The physical properties of gases, liquids and solutions are well described with many useful diagrams and figures and, for an elementary text, there is a very full account of the properties of the colloidal state. On the other hand, the opportunity to bring up to date the section on acids and bases has not been grasped and the very real advantages in unification and simplification offered by the concepts of Lowry and Brönsted have thereby been lost. The section on reaction kinetics is somewhat lacking in clarity and few readers will be satisfied with the statement that the simplest equation, by which the whole course of a reaction may be represented, is called the stoichiometric equation, and the number of molecules appearing on either side of such an equation is the order of the reaction. There is an adequate number of numerical problems for solution by the reader and due attention is paid to the technical and industrial applications of the principles discussed.—R.C.P.

HOME

Nickel Price Increases

The International Nickel Company of Canada, Ltd., and its associated company The Mond Nickel Company, Ltd., announce that, consequent upon the considerable and continued rise in costs, their prices for nickel have been increased, effective 1 June, 1951. The Mond Nickel Company is raising its price for refined nickel in the U.K. to £454 per ton delivered works, with appropriate increases for other countries.

Export Restrictions Remain

Since 1 April this year, exports of semi-manufactures of copper and copper alloys have been restricted to approximately half the rate prevailing in the first six months of 1950. Because of the continuing world shortage in the supply of the raw materials involved, and the high level of demand for these semi-manufactures for essential purposes, it is announced by the Board of Trade that these restrictions are to be extended in the same form for a further period of three months from the end of June. Another announcement will be made before the end of September. Exports of semi-manufactures of zinc will continue to be permitted only in exceptional circumstances.

Sulphur Plans Perfected

Henry Balfour & Co., Ltd., of Leven, Fife, chemical, food and gas engineers, have perfected plans for the development of a new range of units to recover sulphur from coal gas. It is also planned to produce similar equipment to recover sulphur from blast furnace gas in steelworks and flue gases from power plants. This work, which has been speeded up in view of the current scarcity of sulphur, has been under way for a considerable period, under the supervision of Dr. Bahr, formerly of I. G. Farbenindustrie. Licences have been acquired by the company for the manufacture in Britain of plant to his designs and processes and it is hoped to make a start within some three months' time to actual production. The move will not mean any immediate increase in sulphur supplies but rather a long-term policy of recovery and maximum utilisation. The steel industry and gas works are already showing interest in the project.

U.S. Contract for Simon-Carves

A contract worth over £1 million has been secured in competition with leading American and Continental firms, by Simon-Carves, Ltd., of Cheadle Heath, Stockport. The order is for building a battery of 40 coke-ovens at St. Louis, Missouri, U.S.A., for the Great Lakes Carbon Corporation, one of the largest American manufacturers of carbon electrodes for steel furnaces. The coke-ovens, which will carbonise 530 tons of coal a day for the manufacture of high-grade foundry coke, will be of entirely British design and materials and will be constructed under British supervision.

ASLIB Conference

Discussion on the formation of a Midlands branch of the Association of Special Libraries and Information Bureaux will be one of the main topics at a one-day conference of its Northern branch to be held at Birmingham on Thursday, 14 June. The morning session will be devoted to a paper by E. B. Uvaror, technical information officer, Courtaulds, Ltd., Coventry, on 'Some Classification and Indexing Problems in an Industrial Information Bureau.'

Law and the Business Executive

Mr. F. W. Oakley, chairman of the Institute of Industrial Administration will speak on 'Law and the Business Executive' at a meeting of the London Centre Students' and Graduates' Section to be held in conjunction with the London Centre Education Committee, at Management House, Hill Street, London, W.1, on Friday, 15 June at 7.0 p.m. The meeting is open to all who are interested in management, and the lecture will be of assistance not only to students but also to practising executives.

KID Exemptions

The following chemicals have been exempted from Key Industry Duty for the period 4 June to 19 August, 1951: Ammonium bromide, dichlorodiphenyltrichloroethane; diethylaminoethyl alcohol; 4-6-dinitro-o-cresol (OH=1), a nitrocresol; lithium chloride; *p*-nitraniline; 2-nitrodiphenylamine; *p*-toluenesulphonamide; triethanolamine. The Order is the Safeguarding of Industries (Exemption) (No. 6) Order, 1951, published as Statutory Instruments, 1951, No. 946.

• OVERSEAS •

Brazilian Refinery

A petroleum refinery with a daily capacity of 20,000 barrels is to be set up at Capuava, near S. Paulo, by Refinaria e Exploracao de Petroleo Uniao S.A. Refining plant is to be obtained from the U.S.A.

May Produce 'Sponge' Iron

The Norwegian Ministry of Industry states that negotiations are in progress between Norwegian and foreign interests with a view to producing so-called sponge or porous iron in Norway. Sponge iron is a product achieved as the result of many years of experiments by a Swedish engineer, Martin Wiberg, and is very suitable for manufacturing quality steel. A plant for producing sponge iron may be erected at Larvik in South Norway.

Paper from Eucalyptus

A Canadian corporation is to set up a factory near S. Paulo in Brazil for the manufacture of paper from cellulose derived from eucalyptus wood. The corporation plans to plant three million eucalyptus trees this year and a total of twelve million over the next four years. Production of paper is to begin in 1953, and will ultimately be at the rate of 150 tons a day.

Undergoing Expansion

A ten-fold expansion in Israel's chemical industry is underway according to Jan M. Fanto, chemical engineer and New York manager of Fertilisers & Chemicals, Ltd., Haifa, Israel. 'The chemical industry of Israel is small at present', Mr. Fanto said, 'and the plants which we will enlarge for sulphuric acid and superphosphate manufacture in addition to the new ammonia and compound fertiliser plants will increase our production ten times. 'This project,' he said, 'is extremely important, as it will help maintain the standard of living of the Israeli nation and will save about $6,000,000 each year, also it will allow us to export approximately $1,500,000 worth of fertilisers annually.'

Established in 1946, the company's expansion programme is scheduled for completion in 1953. Prior to joining Fertilisers & Chemicals, Ltd., Mr. Fanto served as plant manager of Nitrogen Fertilisers, Ltd., a British firm.

Butanediol From Sugar Beets

Some of the automobile anti-freeze of the near future may be made of sugar beet molasses.

Canadian Government scientists with the National Research Council have found a way through fermentation, to convert this cheap and plentiful by-product into butanediol, 'a valuable and versatile chemical.'

Now, the scientists say, the process is available for some industrialist to use. A plant to produce butanediol this way would cost something more than $2,500,000. The production cost would be around 23 cents a pound.

Extensions Planned

The Brazilian Government is planning an extension of the oil refinery to be erected at Cubatao in the State of S. Paulo, as well as similar installations in the States of Rio de Janeiro and Bahia, in order to bring Brazil's total refining capacity up to 160,000 barrels daily, which would cover the bulk of the country's requirements. In addition, Brazil's deposits of bituminous schist are to be developed; a daily output of 10,000 barrels of fuel from that source being envisaged.

Application of Cerium

Certain 'difficult-to-work' high alloy, corrosion resistant and heat resistant steels can be transformed, it is claimed, into products that can be readily hot worked by means of a new method discovered by the Carpenter Steel Company, Reading, Pennsylvania. The new method, which calls for the proper application of cerium, a rare-earth element, makes it possible to produce the difficult steels in bar, rod, sheet and tube forms. Cerium is obtained domestically from Florida, California and Idaho, but is also found in Brazil and India. According to the company's metallurgists the discovery should enable the steel industry to produce greater quantities of hot workable alloys for many applications such as heat resistant baffles and shields, heat resistant parts for jet and turbo-jet aircraft, and heat and corrosion resistant valves for internal combustion engines.

Publications & Announcements

ALUMINIUM's wide range of applications and the growth of the industry since 1886 are strikingly demonstrated in London at the South Bank Exhibition of the Festival of Britain. From the vast Dome of Discovery and the Skylon, to production processes, and various industries such as farming, food, and packaging and transport, many examples are quoted and illustrated in 'The Aluminium Courier' (No. 15, May), published by the Aluminium Development Association.

* * *

CHROMATOGRAPHIC adsorption is now well established as a means of both quantitative and qualitative analysis. Its chief uses include resolution of mixtures into their components; purification of substances; comparison of substances suspected of being identical; concentration of materials from dilute solutions; and identification and control of technical products. In a leaflet now available from Quickfit & Quartz, Ltd., of Stone, Staffordshire, it is shown that many separations hard to accomplish by classical methods of analysis are now possible by chromatographic adsorption. The glassware illustrated has been designed to provide equipment capable of being rapidly assembled and having the advantages of apparatus built up from interchangeable units. Another leaflet just issued by the company deals with ground-glass joints, and stresses that one or two spherical joints included in an assembly will overcome any difficulties due to rigidity.

* * *

TECHNICAL Booklet No. 8 of the Fire Protection Association just published deals with spontaneous heating and ignition in stored palm kernals. This spontaneous combustion seems to be caused by one of three processes: oxidation of the palm kernel fat by the air; heating to about 70°C. through the activity of micro-organisms under damp conditions, when oxidation is accelerated to ignition point; or the production during this fermentation of some spontaneously inflammable material. The last explanation is taken as the most probable, but experiment has not yet been able to confirm this. It seems imperative to keep the kernels dry.

SALT production and quality are discussed by E. Hirzal in 'Escher Wyss News' (Vol. 21/22) published by Escher Wyss, Ltd., Zurich, Switzerland. The demands of the chemical industry for salt of high purity and fine grain called for special design in evaporation plant. Evaporators built either as thermo-compression units or on the multiple-stage basis are described and illustrated. Practically every chemical process, in one or other of its phases, needs the clarification of liquids, separation of mixtures of liquid and solid matter, the drying of salts and so on. Centrifuges of large output are the subject of an article by E. Ruegg in the same volume.

* * *

AN interesting little booklet which endeavours to present science in an intelligible and interesting fashion to the layman is 'Spotlight on Science, No. 1', by Dr. J. Gordon Cook. This is the first of the series in preparation by Dr. Cook, and it makes a wide variety of subjects very interesting to read about. None of the things it mentions are very comprehensively or analytically dealt with, but they do, probably, what they set out to do, and that is stimulate the layman's interest without bogging him down in a morass of molecules, atoms and chemical ideas that obscure rather than enlighten anyone who is not brought up to them. This issue contains articles on such varied and topical subjects as the South Pole and its potentialities, V.H.F. radio, fluorine plastics, the electronic computer, and monosodium glutamate. Also in it are short news features on weather forecasting, mineral resources of the sea, photosynthesis, wool, trace elements in food, sugar and anti-radiation chemicals. It is very difficult to gauge the amount of simplification required in this sort of work, as every layman has a different knowledge of how science works, but this booklet makes an interesting start. One small criticism—there is no table of contents to wet the appetite, and—might it not help sales to exhibit these in some form on the outside cover? There are so many expositions of science these days, in the Press and on the bookstalls, and the word 'science' may not be enough any more to make the layman snatch a book up and devour it under the eyes of the bookseller.

Next Week's Events

TUESDAY 12 JUNE

Incorporated Plant Engineers

Manchester: Engineers' Club, Albert Square, 7.15 p.m. 'Maintenance of Industrial Instruments.'

THURSDAY 14 JUNE

Incorporated Plant Engineers

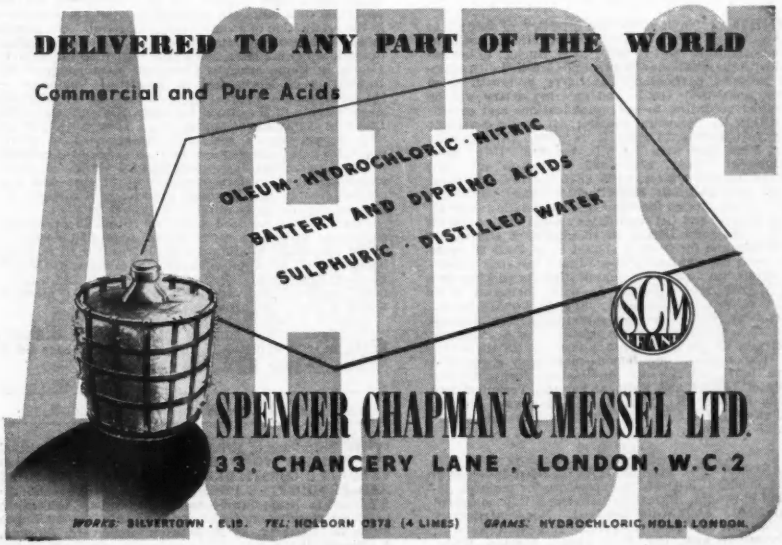
Newcastle-on-Tyne: Roadway House, 8 Oxford Street, 7.30 p.m. 'Industrial Photography.'

The Royal Society

London: Burlington House, Piccadilly, W.1, 4.30 p.m. Professor Sir Cyril Hinshelwood: 'Some Researches on the Physical Chemistry of Bacterial Cells.'

London Market Report

There has been no slackening in the demand for the general run of industrial chemicals during the past week and output continues to be fully absorbed. A good volume of export inquiry has been maintained and on the home market there has been a heavy call from consumers in the textile dyeing and bleaching trades. Price increases received too late for last week's report include copper sulphate, borax and boric acid, the last mentioned items being advances by £2 10s. and £3 per ton respectively. An increase of approximately 30 per cent in the maximum prices of all grades of ground sulphur is permitted as from 1 June. There have been no new features in the coal tar products market and it is not difficult to find buyers for available material. The export demand for cresylic acid is fully sustained and naphthalene continues in strong request at the recently advanced prices.



CLASSIFIED ADVERTISEMENTS

SITUATIONS VACANT

A number of vacancies exist for **MALE LABORATORY ASSISTANTS.** Higher Schools certificate or Matriculation, with some laboratory experience. Age 20-25. Starting wage £4 10s. to £7 15s. per week, according to age, qualifications and experience. Applications to **Laboratory Manager, The Fullers' Earth Union Ltd., Copyhold Works, Redstone Hill, Redhill, Surrey.**

CHEMICAL ENGINEER required for senior position in London, with group of well-known chemical engineers. Applicants should have University Degree, A.M.I.Chem.E. or equivalent, plus several years experience in the industry. Work entails design and commissioning of chemical plants. Contributory Pension Fund. Luncheon facilities. Salary according to qualifications and experience. Write, giving full details, including salary required, experience, etc. Box No. C.A. 3018, THE CHEMICAL AGE, 154, Fleet Street, London, E.C.4.

CHEMICAL ENGINEER. Well known and expanding Anglo-American engineering and contracting firm in City of London requires Chemical Engineer with Honours Degree or its equivalent, together with some refinery and/or industrial experience. The position presents excellent prospects for candidate possessing, in addition to the required academic qualifications and experience, the ability to express his thoughts and ideas both orally and in reports, and a keen desire to keep abreast of latest developments in this profession, both theoretically and practically. Good starting salary commensurate with qualifications and age. Write in strict confidence giving full details of education, qualifications, experience, age and present salary, to **Box Z.D. 3599, Deacon's Advertising, 36 Leadenhall Street, London, E.C.3.**

CHEMISTS are invited by the Ministry of Supply to apply for appointments in the undermentioned grades at the Radiochemical Centre, Amersham, Bucks., to be concerned with the synthesis of compounds labelled with radioactive isotopes, particularly Carbon-14, and with allied research problems. Grade and entering salary will be determined according to age, qualifications and experience within the following ranges: (i) Senior Scientific Officer, £670–£860 with F.S.S.U. benefits. (ii) Scientific Officer, £380–£620 with F.S.S.U. benefits. (iii) Senior Experimental Officer, £705–£895 (minimum age 35). (iv) Experimental Officer, £495–£645 (normal minimum age 28). (v) Assistant Experimental Officer, £220 (at age 18),–£460. Rates for women somewhat lower in all grades. For (i) and (ii) candidates should have a 1st or 2nd Class Honours Degree in chemistry or equivalent qualification and for (i) they should be at least 26 years of age with appropriate post-graduate research experience. Minimum acceptable qualification for (iii) (iv) and (v) is Higher School Certificate with chemistry as a principal subject, or equivalent, but higher qualifications in chemistry would be an advantage. Substantial experience in synthetic organic chemistry or in inorganic chemistry of the rarer elements is desirable for the senior posts. Experience in non-ferrous metallurgy is required for one post. Write for application forms to the **Ministry of Labour and National Service, Technical and Scientific Register (K), York House, Kingsway, London, W.C.2, quoting F.3 5/5 /A. Closing date 21 July, 1951,** H.Q. 1138-30. 5/51. A.B.

VACANCIES exist for **ASSISTANTS,** aged 28-30, with some chemical laboratory experience for research department in Epsom. Education up to Inter. B.Sc. standard or equivalent. Shift work involved. Non-contributory pension scheme and good prospects. Box No. C.A. 3017, THE CHEMICAL AGE, 154, Fleet Street, London, E.C.4.

SITUATIONS VACANT

FULLY qualified **ENGINEER** required for the control of a large design office in London by an Anglo-American engineering firm engaged upon the design and construction of large chemical plants in the United Kingdom and Europe. Applicants must have had extensive drawing office experience in the co-ordination of mechanical, electrical and civil engineering work. A knowledge of chemical engineering is desirable. B.Sc., degree or equivalent essential, and full membership of appropriate Professional Institution desirable.

The post offers scope for considerable further advancement and the starting salary will depend upon qualifications and experience. Write, in confidence, giving details of education, qualifications, experience, age and present salary to **Box No. 67, c/o Browns, 37, Tothill Street, S.W.1.**

PETROCHEMICALS LIMITED invite applications for the following vacancies:—

DRAUGHTSMAN with National Certificate in Mechanical Engineering. Experience in welded structures, vessels, pipe work and steam, water and general chemical installation desirable. Salary in accordance with A.E.S.D. scales.

PLANT ENGINEERS for the planning and supervision of maintenance work. Knowledge of chemical engineering and not less than five years' practical experience on heavy chemical plant are essential. Salary according to qualifications and experience.

Applications should be made in writing to: **THE PERSONNEL MANAGER, PETROCHEMICALS LIMITED, PARTINGTON INDUSTRIAL ESTATE, URMSTON, MANCHESTER.**

WORKS MANAGER required by the Division of Atomic Energy (Production), Ministry of Supply Factory, Capenhurst, near Chester, to be responsible for the operation of a large chemical engineering plant engaged in the production of atomic energy material. The process is a novel one involving unusual techniques in plant operation. Candidates must have either (a) an Honours Degree in Engineering or Corporate Membership of the Institution of Mechanical or Electrical Engineers, or (b) an Honours Degree in Chemistry or Physics and Associateship of the Royal Institute of Chemistry or the Institute of Physics, as appropriate. They must have had wide experience of technical management of plants operating industrial chemical processes and of the management of industrial and non-industrial staffs. A sound appreciation of modern methods of process and cost control, as well as a thorough knowledge of methods for dealing with toxic hazards, is essential.

Salary will be assessed according to qualifications and experience within the range, £1,420 to £1,650 a year.

The successful candidate will be required to serve an initial period of approximately 12 months at M.O.S. Factory, Springfield, Salwick, near Preston, and a house near Chester will be available (if the candidate is married) within a short time after appointment.

There is a voluntary Superannuation Scheme.

Applications to, **Ministry of Supply, D.At.En.(P), Risley, near Warrington, Lancs, quoting reference CB/3.** Rs.6982. 25/5/51. MNW

WORKING NOTICE

THE Proprietor of British Patent No. 481100, entitled **"PROCESS FOR SEPARATING SOLUBLE AND VALUABLE CONSTITUENTS FROM SYLVINITE ORES AND PRODUCT OR PRODUCTS OBTAINED THEREBY,"** offers same for license or otherwise to ensure practical working in Great Britain. Inquiries to **Singeo Stern & Carlberg, 14 E. Jackson Boulevard, Chicago, 4, Illinois, U.S.A.**

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A FILTER PRESS, 31½ in. square, fitted with 42 C.I plates, centre fed.

1½, 2½ and 3½ size belt-driven DISINTEGRATORS by Christy & Norris or Harrison Carter.

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Gardner Size "G" **RAPID SIFTER** and **MIXER,** belt and gear driven.
Two Gardner **RAPID MIXERS** only, 40 in. long, 14 in. wide, one provided with small separate A.C. Motor.
Four **ROTARY BOWL MIXERS,** 5 ft. diam., cast iron built, inclined agitators, by Baker Perkins.

One Broadbent under-driven HYDRO EXTRACTOR self-balancing type, with self-contained A.C motor.

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Large unjacketed WERNER MIXER, belt and gear driven, hand tipping, double "Z" arms, pans 53 in. by 45 in. by 36 in. deep.

No. 200 One nearly new WERNER PFLEIDERER JACKETED MIXER OR INCOPORATOR. Low type, with C.I. built mixing chamber, 28 in. by 29 in. by 27 in. deep, with double "U"-shaped bottom which is jacketed, and double fish-tail or fin-type agitators geared together at one side, with belt-driven friction pulleys, 34 in. diam. by 5 in. face, with hand-wheel operation and hand-operated screw tilting gear. Machine fitted with machine-cut gears covers, gear guard, cast-iron baseplate, and measuring overall approximately 7 ft. by 6 ft. by 4 ft. high to the to of the tipping screw.

No. 209 One HORIZONTAL "U"-SHAPED MIXER, steel built, riveted, mae uring about 8 ft. 3 in. long by 3 ft. wide by 3 ft. 3 in. deep, with horizontal shaft, fitted with bolted-on mixing arms about 18 in. lo g by 4 in. wide, with intermediate breakers, and driven at one end by a pair of spur gears, with countershaft, fast and loose belt pulleys, outer bearing and plug cock type outlet at the opposite end, mounted on two cradles fitted to two R.S.J. running from end to end.

Further details and prices upon application

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TWIN ROLL FLAKING M/C by Bertram, with C.I. rolls 60 in. by 28 in. diam. Drive through helical gearing from 4 ½-h.p. reduction gear box ratio 160-35. Rolls suitable for 40 lb. pressure.
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2 vert. cyl. **MIXERS,** 3 ft. diam by 6 ft. 8 in. deep, on straight with 9 in. cone bottom to 2 in. diam. outlet. Vert. shaft, propellor type agitators. 2½ in. o.d. int. steam coils. Vessels T/E. flat bolted cover with 3 in. and two 1 in. connections. 15 in. diam. manhole in side.
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Horizontal **TROUGH MIXER** 18 in. by 19 in. by 25 in. deep with gate type agitator. Hand tilting. Motorized 400/3/50.
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All sizes of vessels fitted with mixing gear and/or coils.
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